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ABSTRACT

In order to determine if the vocational school graduates are adequately trained for their jobs, a survey eliciting the opinions and suggestions of industrial engineers and administrators who come in contact with the graduates was taken. From the total population of 450 metal plants employing over 20 workers each, a stratified sample of 39 plants was chosen and a questionnaire was used to collect the data. Some of the respondents believed that a broad theoretical basis should be given to vocational students, while others thought more time should be devoted to practical work. Several respondents suggested the introduction of a management and production trend. It was concluded that vocational schools should be diversified, so as to include additional "streams" and levels. (GEB)

THE HENRIETTA SZOLD INSTITUTE

NATIONAL INSTITUTE FOR RESEARCH
IN THE BEHAVIORAL SCIENCES

VOCATIONAL TRAINING AND INDUSTRIAL NEEDS

REPORT ON A PILOT STUDY IN THE METAL WORK INDUSTRY

by

RINA DORON

in co-operation with

A. LEDERER, Eng.

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(Synopsis)

The findings of this survey show such a high measure of consensus that they may be taken as the considered opinion of industrialists in the metal work industry.

With the growth of Israel's industry and its need for superior manpower resources, industrialists think that vocational education should be placed on a par with academic high school education, and should no longer be viewed as a second-rate alternative for those ineligible for academic high school.

It is generally agreed that training for different levels of skill and ability should be provided for.

Posts today filled by workers who never finished elementary school - die setters, assembly workers, general metal workers and iron welders - will in future require men with at least two years' training in fundamental mechanics and other theoretical and practical subjects.

For the majority of occupations listed in the survey, 3- and 4-year vocational schools are thought to provide the best training ground. Many recommend the addition of a 5th

year for specialization in tool making, grinding, cutting, etc.

It was also thought that the 5 year School for Technicians might serve as a possible training centre for production engineers. Students attending advanced vocational training programmes should be in a position to take their matriculation examinations so that their studies may qualify them for admission to the Technion, the Hebrew Technical College in Haifa. Industrial engineers in the metal industry, in general management positions, technical managerial jobs and in planning and development should be vocational school graduates.

Better selection of candidates was recommended, and drastic improvements in the existing vocational schools were suggested, particularly in staff and equipment. The lack of contact between industry and vocational education was deplored. A prevalent opinion was to have fewer and bigger schools with proper industrial equipment. During their studies students should be in contact with industry so as to have a better idea of what to expect from their job. School workshops should as far as possible simulate real plant and factory conditions and work periods should be integrated into the school curriculum. The lack of practical machine work experience of vocational school graduates was generally remarked upon. Some contended

that the schools overemphasize manual craftsmanship at the expense of adequate machine practice while others put the blame on inadequate equipment or the few hours of practical work. Some believed that the summer vacation should be used for this purpose. Another fault noted was lack of familiarity with the basic concepts of production engineering. For senior positions (technicians or foremen) graduates were thought to lack the necessary knowledge of foreign languages and especially technical terms to read professional literature, catalogues and operating instructions. A general complaint was that graduates are not trained to think of their work in economic terms, and have no idea of the cost of labour, and of time and materials saving.

The lack of a sense of precision was felt in all areas: in planning, in performance and in the discharge of responsibilities. This was partly blamed on faulty training in measurement, control, concepts of alternation, and quantative rates. Slightly less serious appeared to be the problem of lack of responsibility and tardiness. The fact that the graduates take no pride in manual work was also deprecated. The ability for independent study of both workers and foremen was found to be undeveloped and undirected.

Industry is expected to undergo considerable changes within the foreseeable future which call for better coordination with the vocational training system. Opportunities should be provided for further training, retraining and refresher courses, which today are the sole responsibility of the industry. A scheme of this kind would not only help workers to gain promotion but would also foster their pride in the work they were doing.

The survey gives no clear indication of the type of training preferred or suggested for foremen. It was stated that foremen should be graduates of a 4-year vocational school.

It was further suggested that the schools should include three main departments or "streams": for production engineering, tool-making, and coating and painting. As the survey was not correlated with quantitative projections, it is not clear whether the establishment of these "streams" is justified. There was no indication of an insufficient quantitative vocational school output. The number of skilled workers, machine-setters and technicians was expected to rise slightly in relation to the total number of production and maintenance workers. Foremen's jobs were said to be filled to capacity, but there was room for additional workers.

A. FOREWORD

Skilled manpower with the necessary training and knowledge is one of the prime assets of a modern economy. Every year hundreds of pupils graduate from vocational schools and many of them try to find jobs in industry.* Are these graduates adequately trained for the jobs which they are called upon to fill? This question becomes increasingly complex in view of rapid changes in the structure and content of skilled occupations in line with modern technological developments. As processes and machines change, so do the skills and knowledge necessary to their operation. A regular flow of information from industry to the planners of vocational education is therefore more essential than ever.

In this survey, conducted on behalf of the Department of Vocational Training of the Ministry of Education and Culture, the Szold Institute has examined the views, opinions and suggestions of industrial engineers and administrators who in the course of their work come into contact with vocational school graduates. The subjects were asked for their considered opinion of the graduates and of the vocational training needed to meet their present and future skilled manpower requirements. The object of the survey was to mediate between the supplier, the vocational training school and the consumer - the industrial enterprise, in order that the output of the schools should be more in line with consumer demands.

* In a follow-up study of vocational school graduates conducted by the Szold Institute in 1963, approximately 44.5% of the graduates were found to be working in factories, plants and workshops. (2)

Although the industrialists interviewed were not professional educators and they represent a variety of opinions most of them were convinced they had something to contribute to the subject. In effect they do represent the present and future potential market for skilled workers.

The quantitative aspects of the recommendations has been disregarded though in order to introduce the recommended changes in the educational system, a quantitative evaluation would be necessary.

The survey presents the subjects' opinions as faithfully as possible and sums up those problems which recur to such an extent as to be considered "the opinion of industrial engineers and administrators in the metal industry". The original intention of the views and opinions expressed has been preserved as far as possible even when it conflicted with the authors' opinions. The survey by no means represents the views of the Szold Institute, the investigators or the members of the Advisory Committee.

In considering these views and recommendations it is also well to note that in planning the vocational school curriculum the Vocational Training Department, in addition to the demands of industry, also has to take into account the experience and opinions of educators and scientists and other factors not dealt with in this survey, as well as pedagogical considerations. The survey does not go into the matter of subjects, teaching methods or the like.

To facilitate evaluation of the views and opinions elicited, a general review of projected developments in other countries is presented together with other investigators' conclusions regarding the quality of vocational training.

In this pilot study we concentrated on a number of subsidiary branches of the metal industry in order to test our method and instruments. The investigation should now be extended to the entire industry. In conducting the survey we were confronted not only by difficulties which naturally arise when dealing with predictions in a field of rapid technological change, but also by the uncertainties due to the prevailing economic situation in Israel.

The authors with to thank Eng. M. Avigad, Head of the Vocational Education Department of the Ministry of Education and Culture, and Dr. R. Bar-Yosef, Eng. A. Glaser, Eng. A. Efron, Mrs. M. Greenberg and Eng. Y. Shrieg, the members of the Advisory Committee of the research project. We are further indebted to the administrators and engineers who, by their cooperation, made this survey possible.

B. EMPLOYMENT FORECASTS IN THE METAL INDUSTRY IN SEVERAL COUNTRIES

1. Development of Industrial Employment

During the last few years the number of industrial employees has grown considerably, as shown by the following table(42):

TABLE A

Growth in share of industrial employees out of total employee population in several countries 1958-1963

Italy	11.3%
West Germany	12.7%
Sweden	12.0%
France	3.5%
Poland	18.5%

The growth was hardly uniform and was affected by the economic situation and population growth of each country. The following predictions for the future are based on different indexes and criteria. Italy(41) predicts an advance in industrial employment from 25.6% in 1959 to 32.2% in 1970. The English forecast(45) deals only with the general growth of employment. France(9) expects an advance of 0.9% in industrial as against 0.7% in total employment between 1965 and 1970. The American forecast(38) predicts that between 1964 and 1970 employment in industry will grow by 14% in industry as against 30% in other sectors, except agriculture.

From these figures it appears that in less developed countries employment is expected to increase more rapidly in industry than in

other branches of the economy, while in developed countries a relative decline in the percentage of industrial employees is foreseen.

Israeli forecasts predict both a relative and absolute rise in the number of industrial employees(5).

TABLE B

Number of employees in Israeli industry, 1964-1971

1964	231,500
1965	234,560
1966	231,400
1970	284,800
1971	300,300

The expected rate of growth for 1970/1971 is 5.2% annually. This means an addition of 70,000 employees during the coming 5 years, or a growth of approximately 30%. The share of industrial employees, out of the total employment, will increase from 26.7% to 29.2%.

2. Employment in the metal industry

The output of various subsidiary branches of the French metal industry is expected to develop as follows by 1970(9):

TABLE C

Annual increase in output of several sub-branches of the French metal industry, 1962-1970

Half-finished products	4.8%
Mechanical engineering products (machinery)	4.5%
Electrical engineering products	7.7%
Cars and motor cycles	5.2%
Ships and aeroplanes	6.5%
Compared with:	
Textiles	4.5%
Agriculture	2.7%
Building	6.3%

According to the official British forecast(45) the output of the metal industry between 1964 and 1970 is expected to grow at the following rates:

TABLE D

Annual increase in output of a number of sub-branches of the British metal industry, 1964-1970

Mechanical machinery industry	5.4%
Electrical machinery industry	5.8% (without electronics)
Vehicle and aeroplane industry	3.6%
Other metal products	2.6%

TABLE D (continued)

Electronics industry	7.4%
Scientific instrument industry	7.3%
Compared with:	
Textiles	4.6%

In 1955-1965 Japanese industrial production[44] has developed as follows:

TABLE E

Production growth in Japan in a number of industries 1955-1965

All industries (including mines)	290%	
Steel and iron industries	310%	
Standard machinery industry	400%	
Transport vehicle industry	680%	(incl. cars but excl. ships and railway carriages)
Electrical machinery industry	950%	
Textile industry	150%	

The data show that the metal industry is ahead of other industries both in its past and in its predicted future development. This development is particularly characteristic of industrializing economies where the metal industry receives preferential treatment.

Israeli forecasts are as follows(5):

TABLE F

Output and employment of electric and metal industry as percentage of total output and employment

	Output	Employment
1965 actual	23.8	31.1
1966 actual	21.3	30.2
1971 expected	25.1	33.0

The figures include the following sub-branches:

TABLE G

Output and employment of sub-branches of the electric and metal industry as percentage of total output and employment, 1965 and 1971

	Output		Employment	
	1965	1971	1965	1971
• Basic metal industry	2.8	2.7	1.9	2.0
Metal products	5.4	5.2	7.6	7.7
Machines and equipment	6.0	7.4	7.2	8.7
Electrical and electronic equipment	3.8	4.2	4.1	4.6
Transport vehicles	5.8	5.6	10.3	10.0

The predicted employment increment during this period is 28,400. The rate of growth is the second largest of all industrial branches. The metal industry is expected to take in 40% of the predicted industrial employment increment.

3. Labour force changes

Drastic changes are predicted in the structure of the labour force. The U.S. Department of Labour gives the following forecasts(35):

TABLE H

U.S. Labour force, by occupational groups, 1960 and 1970
(in millions)

	1960	1970	Increment %
Free professionals			
Technicians and the like	7.5	10.7	43
Managers, senior clerks, owners (excluding farmers)	7.1	8.6	20
Clerks	9.8	12.8	30
Skilled workers, foremen	8.6	10.3	20
Operators and the like	12.0	13.6	14
Servicing workers	8.3	11.1	33
Unskilled workers	3.7	3.7	0
T O T A L	57.0	70.8	

From a German research project(29) it was concluded that automation will lead to a decrease in the number of industrial workers. The need for unskilled workers will be limited while the demand for semi-skilled workers, particularly in maintenance and preparatory jobs, will increase. This conclusion was confirmed by a French study(37) which emphasizes the future demand for technicians. The modifications which occurred in the labour force of a steel plant

and an aluminium processing factory for semi-finished products in Austria - both considered fairly representative - were found to be as follows[30]:

TABLE I

Distribution of workers by occupational groups in two Austrian enterprises 1952 and 1959
(in percentages)

	Steel plant		Aluminium factory	
	1952	1959	1952	1959
Unskilled workers	20.7	20.7	15.5	10.4
Semi-skilled	38.4	42.3	47.7	50.3
Skilled	29.3	26.0	25.9	27.8
Foremen and technicians	7.2	7.6	5.4	7.2
T O T A L	95.6	96.6	94.5	95.7

The planning Division of the Ministry of Trade and Industry in Israel expects the following growth in the number of industrial workers between 1966 - 1971[5]

TABLE J

Predicted increase in number of workers in Israeli industry, by occupational groups 1966 - 1961
(in absolute numbers)

Academicians and managers	2960
Technicians	4400
Skilled	35900
Semi-skilled	25040
Unskilled	25200
Clerks and accountants	4500

To meet the new requirements of industry the occupational structure of industrial personnel is expected to change as follows:

TABLE K

Predicted change in occupational structure of Israel's industrial personnel, 1966 and 1971
(in percent)

	1966	1971
Academicians and managers	2.9	3.2
Technicians	2.5	3.2
Skilled workers	38.5	37.4
Semi-skilled workers	28.7	29.0
Unskilled workers	22.0	22.1
Clerks and accountants	5.4	5.1
T O T A L	100.0	100.0

In line with general world trends there is an expected demand for workers with vocational training and especially for highly skilled workers or "technicians".

C. MODIFICATIONS IN VOCATIONAL TRAINING PROGRAMMES

1. The technological revolution

We are living in a technological era of dynamic change. The gross national product of Japan has jumped up 150% since 1955(44); the per capita oil refining output in England has advanced by 10% annually from 1960 to 1964;(45) the total output per working hour in private industry in the United States has risen by 200% from 1919 to 1960(38) and by 1970 is expected to be twice that of 1947(16). Before World War I it took approximately 30 years for a technical innovation to be fully exploited in economic terms; after World War II the time-lag has been reduced by 9 years. It took only about 15 years to change all the old steam engines for diesel engines in all the big railway companies in the United States(38). The introduction of the transistor increased U.S. sales of semi-conductive products by approximately 90% each year between 1948 and 1958. A French research project(20) predicts major developments in the space industry, electronics and plastic products, travel, communications and medical services, cultural activities and "leisure" industries; and increasing concern with water supply and air purification problems. It is expected that by 1985, 3% of the gross national product will be in research instead of today's 1.5%. An American forecast(16) predicts a rise in research expenditure, from about 12 billion dollars in 1960 to approximately 27 billion dollars by 1969.

Since the only thing that seems certain is change, it is difficult to make any forecasts about education and teaching material.

An American researcher predicts interesting developments in[38]:

1. Super conductivity, choreogenics.
2. New conversion methods between different types of energy.
3. High-temperature resistant materials.
4. Materials used in nuclear physics and in nuclear power installations.
5. Utilization of materials and instruments based on rare metal-ores.
6. Metallurgy of beryllium, columbium, ruthenium, titanium, tantalum, vanadium, tungsten, zirconium.
7. New dielectric and magnetic articles.
8. Imperfections in solids.

This list has no immediate significance for vocational schools, yet tomorrow today's students might have to tackle some of its practical implications. It therefore seems imperative that vocational training should be in a constant state of renewal in order to keep abreast of modern developments.

Curricula must be constantly adapted and the teaching staff should be required to attend frequent refresher courses.

2. Occupational changes in the metal industry

In a study of the French machine industry[32] conducted in 1965, it was concluded that the number of foundry workers handling

the material will decrease; automation will cut down the demand for skilled workers, but more semi-skilled workers will be required to operate and set the machinery. In metal machining the introduction of automatic multiple spindle presses will lead to the dismissal of semi-skilled workers and machine-setters. Cold pressing is expected partly to replace lathe work, so that fewer workers with much less skill will be required. Fewer skilled workers will also be required for processing small series, while automatic transfer in medium and large series will increase the demand for skilled maintenance workers and production technicians. The number of skilled setters in workshops will decrease by 50%, and be replaced by semi-skilled workers. In body workshops, more setters and maintenance workers and fewer skilled welders will be needed. In maintenance workshops the report states that it is already difficult to find people with the technological knowledge necessary to meet constantly new demands. More highly skilled workers will be needed in the electricity and electronics industry. Even in machinery and tool making less skill will probably be required in the future.

The introduction of copying machines or metal processing machines operated by a computer is to be expected and much progress will probably be made in electrical or chemical erosion. Plastic materials are already threatening the wooden crate industry[31].

A national French forecast[9] predicts that from 1962 to 1970 the number of draughtsmen will increase by 60%, of technicians by 56%, of foremen and team leaders by 39%, and of skilled workers by 14%.

Other studies give first place to modern maintenance which requires a knowledge of pneumatics and hydraulics[26, 31], also stressing the prominence of electricians with a knowledge of electronics[26, 31] and of fine metal tool makers[26]. According to an American forecast, however, the demand for skilled workers will probably decrease for engineers as technicians will operate machines working under numerical control[31], and for the rest semi-skilled workers will be sufficient.

Other essential occupations in tomorrow's industry are technicians[34], draughtsmen, laboratory research workers or mechanics responsible for the automatic equipment; coordinators who coordinate the various activities of the enterprise; and supervisors who are the leaders of a team[34]. Emphasis on these jobs recurs in other studies. A German investigator, on the other hand, stresses the following occupations[47]:

1. Operator: supplies material, starts and stops the process, supervises and coordinates, responds to control signals, makes simple check-ups, collects data and cleans the machine.

2. General component setter: coordinates, sets and repairs automatic machines.

3. Maintenance mechanic: services, repairs and performs general overhauls.

4. Motor setter.

5. Technician: prepares work and supervises the maintenance.

We find that the forecasts predict an ever growing trend towards automation. There will be less dependence on highly skilled workers (engraver, moulder, body-worker, etc.) except for a few particularly highly skilled ones. On the other hand, the demand for setters and maintenance workers will grow. They will need a knowledge of pneumatics and hydraulics and the electricians among them also of electronics. At the medium level, the demand for technical managers, team leaders, preparatory workers and technicians will grow to take charge of the semi-skilled operators of automatic or semi-automatic equipment.

3. Implications for vocational training

In Europe and in the United States, there is general agreement that the numerical output of the vocational schools is insufficient and vocational training should be developed at the expense of apprenticeship schemes(19). This does not necessarily apply to Israel where there is no long tradition of apprenticeship training.

It is generally agreed that drastic changes will take place in the occupations required so that the training programme should be

directed towards a certain level of vocational knowledge with less insistence on any one specific occupation(24). Specialized training should be limited to a number of selected occupations and the length of the training period should be reduced(19).

Specialization and automation require skilled workers to have a higher standard of training and be able to change from one job to another. For example, a machine-setter's job will be done by a machinist able to produce extremely fine work and at the same time to operate the tools of the engraver and the tool-maker. Also maintenance workers will belong to this group possessing "polyvalent training"(37).

Another author insists that in the future a broader range of knowledge and comprehensive basic training are required so that the worker should have a large number of skills which will enable him to change his occupation several times during his working life. For instance, a modern machinist can no longer be totally ignorant about electricity(7).

Education will have to go on long after the fundamentals have been learned at school. Supplementary training or retraining courses will become increasingly necessary. Skilled workers will have to up-date their knowledge or learn new occupations. Thus a French study describes an enterprise employing 2650 workers which produces materials and parts for computers using the most up-to-date physical and chemical processes (ultra-sonic, etc.). Many of the "chemists and physicists" were former machinists, retrained in special courses since

conventional machines were abandoned[7].

Traits to be developed by vocational training

It is contended that the vocational school must provide a broad basis of general knowledge[13, 24] and develop several traits which the future industrial worker is called upon to possess. The traits which should be developed are: creative imagination, logic, independent thinking, ability to concentrate, preparedness, quickness of response, quickness of decision, dedication, responsibility, endurance, readiness and ability for team work and the ability to adjust to changes[7, 8, 47, 25]. The psychological background should be such as to enable workers to augment their school training as they grow older[17]. Schools must produce workers able to learn a new occupation with facility[11]. Closer relations are needed between industry and vocational training personnel[13] to facilitate the incorporation of current changes in the curriculum, which should also include projects based on actual industrial problems[43].

There is a school of thought which says that the development is such that no predesigned curriculum can be drawn up and suggests that vocational education should consist of a programme of complementary studies graduated to various levels[29].

It appears that a new approach to vocational training is needed and that it can no longer be regarded as an inferior branch of

education[12]. It is the basis on which a man builds his future by continuing his studies according to his needs and ability and according to the needs of industry as they develop[19].

D. VOCATIONAL TRAINING IN ISRAEL

1. Apprenticeship(21)

In 1953 the Knesset passed the Apprenticeship Law to protect occupations declared by the Minister of Labour to be "apprenticeship occupations". Youngsters learning an "apprenticeship occupation" are "apprentices", and those learning occupations not included in the Law are "novices".

In 1966/67* there were 15,140 apprentices in 45 "apprenticeship occupations". Every apprentice has to attend accredited vocational classes, that is, an Apprenticeship School for theoretical study and, very often, also practical training, and must take intermediate examinations and pass final State examinations at the end of his apprenticeship. Successful graduates are awarded a diploma which, according to the Employment Service Act, entitles them to be called skilled workers.

The apprenticeship scheme includes also the following facilities:

Guided Apprenticeship - courses for elementary school graduates in occupations for which a larger number of apprentices is needed. The courses extend over a period of from 3 to 11 months in Adult Training Centres, Apprenticeship Schools and Vocational Schools. On the basis of final examination results the Director of Apprentices reviews the training period of each student.

*Data supplied by the Department of Youth and Education of the Ministry of Labour.

Intensive Apprenticeship. The Ministry of Labour offers 3 study evenings and one day of concentrated study to approximately 10% of the more gifted apprentices, to raise their standard to the level of vocational school graduates.

Industrial School, similar to apprenticeship schools at large industrial enterprises abroad. During the first year the programme is the same as in Guided Apprenticeship. The second year is spent in study workshops and afterwards the student-apprentice works in the production plants. The level is the same as in Intensive Apprenticeship, with a relatively large number of theoretical classes.

In addition the Ministry of Labour, in coordination with the Israel Defence Forces, offers courses for 16 - 17 year old adolescents in civilian occupations in which the army takes an interest and in which it undertakes to employ the participants during their army service. Then there are evening classes for skilled workers. The Ministry of Labour in cooperation with the Ministry of Education and Culture, with "Ort", the Technion, the Labour Federation (Histadrut) and the Industrialists' Association also supports a special Training Institute for teaching personnel, foremen and technicians. Further training is given in occupations which can be learned on the job (the textile branches, diamonds, etc.) with the Ministry of Labour paying part of the trainees' salary. The Ministry of Labour also offers Adult Courses and courses for the vocational rehabilitation of the handicapped.

2. Vocational Schools(1)

Unlike the "apprenticeship" scheme which is largely based on in-service training, the vocational schools operate like regular schools and have been under the supervision of the Vocational Training Department of the Ministry of Education and Culture since 1960. The length of the course varies with the trade from two to four years. In addition to the regular two, three and four year vocational schools there are the following facilities:

1. Academic high school with vocational stream (introduced in 1967 in 51 Jewish schools and 3 Minority schools). Here about 25 hours a week are spent on the regular high school curriculum and 17 hours on theoretical and practical vocational studies.

2. Institutes for Technicians (of which 3 were operating in the country in 1967). A term of 300-400 hours after four years vocational school, in which students qualify as technicians and learn planning, control and organization, testing and ordering of materials and equipment, high level auxiliary technical and engineering tasks, supervision of production and management of a production workshop.

3. Institutes for Engineering Technicians (of which 4 were operating in the country in 1967). A $3\frac{1}{2}$ to 4 year course (approximately 4,500 - 5,000 hours) beginning with the 11th grade in which students are taught to collaborate in engineering and scientific research and are trained in developmental and experimental work, planning, technical

calculations, maintenance, and the technical management of medium-sized plants.

Of the total of 44,917 vocational school students in 1967, 10,551 attended programmes qualifying them for work in the metal industry.* Of the 15,140 apprentices 9,137** were being trained as skilled metal workers.*** This means that 33% of all youngsters receiving vocational training in 1967 were due to go into the metal industry.

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*Fine mechanics, lathe operator, instrumentation, metal-worker, agro-mechanics, auto-mechanics, aero-mechanics, electro-mechanics, electro-accoustics, electronics, telecommunications, heavy mechanical equipment, refrigeration, radio, tool-making, draughtsmanship, metal plating and coating.

**Data supplied by the Youth and Vocational Training Department of the Ministry of Labour.

***Electricity, auto-electrics, plumbing, sheet-metal worker, auto-mechanics, general mechanics, construction metal-worker, lathe operator, refrigeration, radio-electronics, aero-mechanics.

E. SURVEY METHOD

From the total population of 450 metal plants employing over 20 workers each, a sample of 39 plants was chosen.

The population was stratified by sub-branch and plant size. The sub-branches were:

1. Basic Metals.
2. Metal products.
3. Machinery.
4. Electric and electronic equipment.
5. Transport vehicles (excl. garages).

From each stratum a random sample was taken proportionate to its share in the total employment of the metal branch.(See Appendix A).

Ten plants not included in this random stratified sample were also investigated because it seemed necessary to include them in any projection of future production trends and processes. The statistical findings refer solely to the plants included in the sample, but the views of these additional 10 plants are taken into account in considering the future of vocational training.

During September-October, 1966, we interviewed those engineers, managers and administrators who according to the plant management were familiar with production and with personnel matters. The questionnaire (See Appendix E) comprised a list of the most common skills and occupations in the metal branch. The subjects were asked to supplement this list and specify the appropriate training for each occupation. They

were further asked to suggest which types of training should be given priority and what modifications are likely to occur in the structure and contents of occupations and the skill and knowledge they require.

Opinions, suggestions and recommendations for vocational school training - now and in the future - were also solicited.

The survey relates solely to the metal industry although it should be remembered that some of the occupations may also be found in other industries (a lathe operator may work in a plastic products plant or a boiler man in a food factory) and that sometimes they cover different tasks some of which appertain to other industries.

F. PREDICTED MODIFICATIONS IN PERSONNEL STRUCTURE

Opinions were solicited on skilled workers, machine-setters, technicians (mainly production technicians), quality control men and foremen.

Only 29 of the 39 plants ventured an opinion on predicted modifications in the personnel structure. It was frequently contended that the prevailing economic slowdown made predictions impossible. To be able to draw inferences from the replies received regarding the changes predicted in each stratum it was assumed that:

1. The plants will continue to belong to the same sub-branch and size group.
2. The ratio between production and maintenance workers in plants of the same stratum will remain the same.
3. The views solicited from a number of plants in a stratum are regarded as representative of the whole stratum.

Since any prediction is of necessity hypothetical, the findings (Appendix B) may well be taken to represent the subjects' opinions despite the obvious limitation of these assumptions.

The modifications predicted vary with plant size, with a clear line drawn between small plants (up to 100 workers) and big plants (100 workers and more). The percentage of skilled workers out of the total number of production and maintenance workers in the "small" plants is expected to rise. Not so in the big plants, where in the sub-branches of Metal Products and Transport Vehicles it is even

expected to decline.* This does not apply to machine-setters, technicians (mainly production technicians) and quality control men. Here a relative increase is expected in the big plants and a slight drop or no change in the "small" ones. The implication is that the personnel structure of the big plants will be affected by automation. Apparently, there will be no conspicuous rise in the percentage of workers employed as foremen. The current opinion was that the present team of foremen could supervise a larger number of workers.

The data in Appendix B must be approached with a certain amount of caution for, in addition to the limitations mentioned, the small sample size leads to large sampling errors. They are merely supplementary to the survey findings and provide a pointer to a possible method of quantitative analysis with a larger sample.

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*It should be remembered that these opinions were given before the Six Day War.

G. REQUIRED VOCATIONAL TRAINING FOR PROJECTED STRUCTURE AND CONTENT OF OCCUPATIONS

The occupations, present and future, which according to the subjects require trained people, not supplied under the present programmes, have been divided into the following groups (See Appendix C):

1. Technicians, sub-divided into control and organization men - quality control, production process, and productivity technicians - and into technical experts in casting, engineering (aviation), office automation, refrigeration and piping.

2. Electronics and instrumentation technicians - electronic technicians, operators, instrumentation specialists, electro-mechanic tool-operators, electronic laboratory workers, aircraft wiring experts, hydraulics (aircraft) technicians.

3. Welding: aluminium welder, non-ferrous metal welder (T.I.G. and others), operator of automatic welding machines.

4. Mechanical metal work: duplication lathe operator, miscellaneous grinders, jig grinder, jig borer, electro-erosion machine operator.

5. Coating and plating: paint technician, dip painter, coater, plastic-coater.

6. Machining and components: rolling-machine operator, assembly-line operator, progressive-roller operator, skilled assemblyman.

7. Electricity: motor winding, control-board assembly.

As in the rest of the world there is a demand for highly trained technical workers (see Appendix C) of wide experience,

whose theoretical knowledge is augmented by a sound practical background so that without being engineers they are able to fill senior positions. Today, to the extent these positions are filled, most of the people who occupy them are self-made men - skilled workers who took extra courses and studied on their own.

The increased demand for tool-making, electronics, hydraulics and so on (see Appendix C) represents a well-known trend.

The predicted developments in the welding of non-ferrous materials and modern instrumentation correspond with general world trends; it should be noted that the demand is already extant. Also in metal machining the trend is a general one, but here it should be noted that there is a demand for certain long-familiar occupations for which no training facilities are available in the country.

There is a special demand for decorative and protective coating specialists for whom no local training is available despite the growing interest in this field.

The demand for machine operators is in line with foreign forecasts[47]. No highly skilled workers are required here, but workers with some vocational background, and with the special aptitudes needed for operating uncomplicated but very expensive equipment - quick and correct response, responsibility and alertness.

The demand for different types of machine-setters from those currently employed is conspicuously absent, apparently because industrialists do not perceive of this as a new occupation but merely as a modification of an existing one.

II. PREFERRED TRAINING FOR EXISTING OCCUPATIONS

The subjects were asked their opinion on the kind of training required for the occupations represented in their plant out of the list set out in the questionnaire.

The distribution of opinions is graphically presented in Appendix D. In regard to the majority of occupations, there commonly is one prevailing opinion recommending a specific kind of training. In some occupations there are two schools of thought, and in isolated instances more than two.

The type of training suggested for the various occupations is set out below. When two or more types of training are suggested for the same occupation the occupation is repeated under each.

Apprenticeship.

Blacksmith*, hammerer*, forger*, furnace operator* (metal temperer and hardener), tinsmith, welder (general*, iron), auto mechanic.

2-year vocational school.

Metal construction, general metal worker (welding, assembly), metal machining (mechanical metal work), die setter, machine setter, tinsmith, welder*.

3-year vocational school.

Metal construction, general metal work (welding, assembly), metal machining (mechanical metal work), lathe operator, die setter, vehicle mechanic.

*Occupations on which there was general consensus.

4-year vocational school.

Foreman*, instrumentation (maintenance of mechanisms and instruments)*, metal processing machine setter*, die caster*, electrician*, mechanic (motor maintenance)*, lathe operator*, skilled quality controller, metal construction, general metal work (welding, assembly), metal machining (mechanical locksmith), machine setters, auto mechanic.

School for technicians.

Production technician*, technician (engineering)*, technician (specialized)*, skilled quality controller.

While certain occupations apparently call for more than 4 years' training, for others 2 years' training seems to be sufficient. Although in general terms the subjects frequently advocated in-service training there were few recommendations to that effect regarding specific occupations, perhaps because the enterprises are not big enough to support their own industrial schools**. Another reason may be that although this method of training the specific workers in the specific jobs and skills needed by the enterprise may be the most worth while for the plant and to some extent cut down the labour turnover it is liable to limit the worker's mobility, and here the opinions were expressed from the workers' point of view.

Vocational training at ordinary high schools (vocational streams or courses for graduates) are apparently not considered effective.

*Occupations on which there was general consensus.

**It should be noted that one plant had to close its Industrial School because boys under the age of 18 were forbidden by law to work excentric dies. The management protested that it was almost impossible to learn the job in any other framework.

I. RECOMMENDED NEW OPTIONS FOR VOCATIONAL SCHOOLS OR SCHOOLS FOR TECHNICIANS

The subjects were asked to suggest new options to be included in the vocational school programme, to train workers whose current training is inadequate.

TABLE L

Recommended new options in vocational schools or schools for technicians

New Option	Occupations	No. of recommendations
1. Metal work		
Foremen and production technicians	Foreman, team leader, production technician, skilled quality controller, technical clerk, technical expert.	20
Painting and coating	Technical expert, painting expert, metal coater, metal milling.	6
Tool-making and jig boring	Die-setter, jig borer (for instrumentation) planer, grinder of cutting tools for tool-making, universal grinder for tool-making, internal grinder for tool-making, electro-erosion, mechanical machining by numerical control, tool constructor.	5
Hydraulics and pneumatics	Hydraulic technician, quality controller, equipment technician, aviation hydraulics.	3
Motor winding	Motor winder	2
Metal sheet work	Metal sheet worker, aeronautics plating technician	2
Metal machining, specializations	Grinding-centreless grinder, internal diameter grinder, tool grinder	1
	Milling - precision miller	1

*Single opinions are included since the significance of the opinion in this case is not determined by the number of times it recurs.

TABLE L (continued)

New Option	Occupations	No. of recommendations
Electro-mechanics	Electromechanic tool-operator, electronic laboratory technician, electronics technician, fine technical instruments-operator, foreman, production technician.	1
Machine maintenance	General metal worker (welding, assembly).	1
Casting	Manual caster.	1
Steam boilers	Expert technician.	1
Heavy mechanical equipment	Heavy mechanical equipment technician.	1
Piping	Pipe fitter.	1
Aluminium processing	Aluminium welder (in assembly and welding machines).	1
2. Other Options		
Upholstering	Upholsterer, carpenter.	2
Plastics	Technical expert, machine operator.	1
Printing and photography	Offset printer, plate photographer and technician.	1
Vehicle glazing	Vehicle glazier	1
Storekeeping	Storekeeper	1

Most subjects seem concerned about the lack of training facilities in management and planning, where emphasis is placed on efficiency and work productivity -including quality control, norm and premium assessment- and a knowledge of economics, statistics, sociology and psychology required in order to handle the human factor in industry. It should be noted in this context that many vocational school graduates fill managerial and supervisory positions.*

It was also stated that even people trained in planning and management should be made to realize that they need industrial experience before they can successfully cope with such jobs. No plan can be made or applied without thorough practical experience. Only a man who has himself held a job as a skilled worker is able to perform these functions. To inculcate this principle a period of training in industry is suggested as part of the vocational training programme (see Chapter XIII).

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*A follow-up study made by the Szold Institute has shown that of the graduates who continue in the same or in an allied occupation approximately 12% fill managerial or supervisory posts and about 13% work as technicians (mainly production technicians), so that about 25% were in planning, managerial and supervisory positions (2).

J. MACHINES, INSTRUMENTS AND TECHNIQUES TO BE INCLUDED IN THE VOCATIONAL TRAINING PROGRAMME

A frequently recurring contention was that the vocational school graduates have an inadequate practical knowledge of machine work. Several subjects complained of the misplaced emphasis on manual skills (filing, smooth-finishing) which leaves little time for machine work. Others thought that the course was not long enough for adequate machine training. Still others suggested that the inadequate equipment available in the schools was to blame. Metal machining equipment with which graduates were reported to be unfamiliar covered a broad range and included:

Planing machines

Horizontal Boring Mills, Multiple Hinge Borers

Planer

Jig Borer

Lathe with Horizontal Plane

Duplicating machines: lathe
precision mill

Tool Grinding Machines (internal diam. and centerless and with copying devices on the grind stone)

Hobbing Machines

Semi-automatic and Revolver Lathes with electronic control.

These machines are currently in use. Other machines expected to be introduced or used to a larger extent are:

Lathes and other numerically controlled machines

Photograph metal machining devices (i.e. with copying arrangements)

Machines with pneumatic and hydraulic control elements

Ultrasonic electric and chemical erosion equipment

Equipment for surface treatment.

In areas other than metal machining the following machines were mentioned:

Excenter Presses

Extrusion Presses

Disc Saws

Hot and cold bending machines

Universal Bending machines

Gauges: Mechanical, Optical, Pneumatic, Electronic, Magnetic, Surface Finish.

Pressure Moulding Equipment for metals and plastics

Pressure Moulding Machines

Shell Moulding

Precision Moulding Machines

Hardening devices.

The need for familiarity with modern non-ferrous welding and soldering methods (Argon and T.I.G. machines, etc.) was repeatedly stressed. Automatic welding machine operators, automatic cutting machine operators and point welding specialists are already needed

and the demand for both manual and mechanical welding is expected to grow. Developments are also predicted in ultrasonic soldering and metal joining. More knowledge of control instruments for automated machinery is required.

Regarding welding the need for broader knowledge of the new metals not yet fully introduced in Israel, and of modern testing methods and quality grades is stressed. A course on advanced welding methods for selected apprentices seems to be indicated and a marked development of this area seems called for.

More practice in the use of pneumatic, electric and hydraulic machines was advocated as well as a better knowledge of the principles of pneumatics and hydraulics in view of increasing automation.

Regarding the technology of metal machining the subjects stipulated a knowledge of:

Hard metal work (including processing speeds, cutting angles, etc.)

Gauges and other measuring devices (mechanical, optical, pneumatic, electronic, magnetic and surface finish)

Serial production methods - disposable and fixed casts and dies

Fixed and variable measuring devices

Adjustable cutting devices

American technical draughtsmanship standards

Different bores

Concepts of interchangeability and tolerance.

These needs were noted repeatedly. For the future a knowledge of ceramic and diamond cutting tools was also mentioned.

K. AREAS OF KNOWLEDGE, SKILLS AND ABILITIES TO BE STRESSED IN VOCATIONAL TRAINING

1. The qualifications of vocational school graduates and the needs of industry

The subjects were asked to evaluate vocational school graduates in the light of plant requirements, by ranking their achievements in various disciplines and skills on a 5 point scale, according to how they performed in their jobs as skilled workers, foremen and supervisors. (See Questionnaire in Appendix E).

In spite of the many limitations of such a questionnaire (lack of standard evaluation criteria, random impressions, etc.) we think that this ranking gives a good indication of the extent of correspondence between what the plants needed and what the graduates were able to offer in these fields.

Scores 1 - 3 are negative (extremely unsatisfactory, unsatisfactory, nearly unsatisfactory) while scores 4 and 5 are positive (satisfactory, most satisfactory). Since subjects hardly tend to record extremely negative evaluations we saw fit to find out how many of them made a negative evaluation (1 - 3) or a positive evaluation (4 or 5). This was done by computing cumulative percentages of the scores. In addition, the most frequent score for each trait, ability and skill was noted.

Table XIII shows that industrialists find no serious fault with graduates employed as skilled workers, though their theoretical knowledge

of the trade seems to need improvement. There is a wide range of opinions regarding their knowledge of production engineering but this may be due to confusion with the more general concept of "thinking in economic terms" which appears later in the list and was evaluated relatively lower. A wide range of evaluations also appears regarding practical vocational knowledge and foreign languages. Some of the subjects seem fairly satisfied, while others note a considerable discrepancy between demand and supply.

TABLE M

Evaluations of vocational school graduates employed as skilled workers.
(in cumulative percentages)

evaluation / Areas of knowledge, abilities & skills	negative evaluation: extremely unsatisfactory 1	unsatisfactory 2	nearly unsatisfactory 3	positive evaluation: satisfactory 4	most satisfactory 5	total no. of evals.	eval. frequency
Areas of knowledge							
1. Foreign languages	6	23	34	54	100	35	5
2. Theoretical scientific knowledge (maths., physics, chemistry)	-	12	27	52	100	33	5
3. Theoretical vocational knowledge (mechanics, electricity, etc.)	--	12	47	91	100	34	4
4. Reading and understanding blueprints	-	12	36	80	100	34	4
5. Practical vocational knowledge (practical work)	8	14	28	70	100	36	4
6. Knowledge of production engineering (cost accounting, industrial efficiency, etc.)	11	22	42	53	100	36	.5
Abilities & skills.							
1. Written expression	3	9	27	36	100	33	5
2. Oral expression	-	-	15	57	100	33	4,5
3. Independent study	9	27	48	75	100	33	4
4. Adjustment to change	-	10	48	76	100	29	3
5. Thinking in economic terms	19	32	64	77	100	31	3
6. Pride in manual work	16	29	52	81	100	31	4
7. Responsibility	3	22	53	95	100	36	3
8. Alertness	4	8	54	81	100	27	3
9. Accuracy	6	29	65	97	100	31	3
10. Three-dimensional perspective	9	-	54	68	100	22	3

TABLE X

Evaluations of vocational school graduates employed as foremen and supervisors.
(in cumulative percentages)

evaluation Areas of knowledge, abilities and skills	negative evaluation extremely unsatis-factory 1	 unsatis-factory 2	 nearly unsatis-factory 3	postive evaluation satis-factory 4	 most satis-factory 5	total no.of evals.	eval. fre-quency
Areas of knowledge							
1. Foreign languages	16	41	60	94	100	32	4
2. Theoretical scientific knowledge (maths., physics, chemistry)	-	7	38	62	100	29	5
3. Theoretical vocational knowledge (mechanics, electricity, etc.)	3	15	37	78	100	32	4
4. Reading and understanding blueprints	-	3	13	53	100	30	5
5. Practical vocational knowledge (practical work)	9	15	27	63	100	33	4.5
6. Knowledge of production engineering (cost accounting, industrial efficiency, etc.)	12	32	70	82	100	34	4
Abilities and skills.							
1. Written expression	3	19	56	75	100	32	3
2. Oral expression	3	10	30	63	100	30	5
3. Independent study	6	29	58	90	100	31	4
4. Adjustment to change	-	7	34	80	100	30	4
5. Thinking in economic terms	13	26	65	91	100	31	3
6. Pride in manual work	14	21	39	71	100	28	4
7. Responsibility	19	18	45	77	100	22	4
8. Alertness	-	8	33	71	100	24	4
9. Accuracy	3	24	48	86	100	29	4
10. Three dimensional perspective	4	13	26	61	100	23	5

Evaluations of skills and abilities are lower, and there is a clear trend of opinion. The principal complaints are about thinking in economic terms, pride in manual work, responsibility, alertness, accuracy and three-dimensional perspective. As they also stated in a different context, the subjects hold that vocational school graduates are not made sufficiently aware of the importance of accuracy* and quick performance. The capacity for independent study should also be fostered though here opinions are divided. Other qualifications not appearing in Table XIII and added by several subjects are: careful handling of equipment, neatness and tidyness, the ability to maintain human relationships and education towards team work.

The table shows that skilled workers score lower in "abilities and skills" than in "knowledge", perhaps because it is easier to make up a deficiency in knowledge.

Table N shows that the demands made on foremen and supervisors are slightly different. On the knowledge side the graduates seem to be deficient in foreign languages and production engineering. Regarding "Abilities and Skills" the need for greater awareness of the economics of production (thinking in economic terms) is again stressed and the low standard of "independent study" and "written expression" is generally deplored.

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* One of the subjects suggested they should be taught how to tighten screws properly, particularly with clock spanners, since not only motor mechanics were at fault in this respect.

2. Qualifications to be developed in line with future needs

The subjects were asked to consider the qualifications listed in relation to future needs, to indicate possible modifications in vocational training in line with the changing functions of skilled workers, foremen and supervisors. The distribution of opinion is shown in Table O.

TABLE O

Distribution of opinion on future Qualifications of skilled workers, foremen and supervisors.

Areas of knowledge, abilities & skills.	skilled workers	foremen and supervisors
Areas of knowledge		
Foreign languages	3	8
Theoretical scientific knowledge	4	1
Theoretical vocational knowledge	14	11
Reading and understanding blueprints	6	5
Practical vocational knowledge	10	6
Knowledge of production engineering	2	12
Abilities & Skills		
Written expression	2	3
Oral expression	2	5
Independent study	8	6
Adjustment to change	8	5
Thinking in economic terms	2	6
Pride in manual work	7	1
Responsibility	8	6
Alertness	3	2
Accuracy	11	8
Three dimensional perspective	3	2

Regarding skilled workers the prevailing opinion calls for the development of theoretical vocational knowledge, practical vocational knowledge, accuracy, independent study, adjustment to change, responsibility, pride in manual work and reading and understanding blueprints. For foremen and supervisors, the majority of subjects suggested that graduates should have a better knowledge of production engineering, vocational theory and practice and foreign languages, and should develop their ability for accuracy, independent study, economic thinking and responsibility.

The majority opinion seems to be that, in addition to practical experience, vocational school students should be given general training based on broad theoretical knowledge, and that their intellectual abilities should be developed so that they may be able to adjust to the rapid changes foreseen in the industrial world of the future. Many believe that graduates should have a better knowledge of foreign languages, particularly those due to occupy planning and supervisory positions. They should be familiar with technical terms so as to be able to use catalogues and read blueprints and be able to get on in their job.

L. THE VOCATIONAL SCHOOL AS A PRELIMINARY STAGE FOR MECHANICAL AND PRODUCTION ENGINEER

An average of 15.4% of vocational school graduates goes on to study engineering[2], and it has been suggested that the vocational school training they received was a waste of time and money since the investment in a vocational school graduate is many times higher than in an ordinary high school graduate. To verify this contention the subjects were asked whether in certain jobs vocational school training was an effective background for engineers. The distribution of opinion is given in Table P below.

TABLE P

Attitudes of vocational school training for certain kinds of engineering jobs.

Kinds of jobs	for	against	total
General management	19	7	26
Technical management	32	1	33
Planning and development	30	3	33
Marketing	13	11	24

The majority of subjects thought that vocational school training contributes to success in general management, technical management and planning and development jobs. About marketing jobs opinions were divided. It should be noted that academic high school training was not proposed as an alternative. The findings might have been slightly different if this alternative had been proposed.

M. MISCELLANEOUS OPINIONS & SUGGESTIONS

Many subjects emphasized the importance of practical and particularly of machine work during the training period and it was suggested to increase the number of hours on such work which should be as close as possible to actual production procedures.

Another majority opinion was that vocational students should be made industry-minded, either by courses held in various plants during the summer vacations, or by an extra year of practical training in factories and workshops. Graduates have insufficient information about the type of job they may be able to take on and about what it means to work in a factory or workshop. As one of the subjects put it - "advance knowledge of formal and informal industrial organization is essential to success as an industrial worker". Many of the subjects thought that a closer acquaintance with the workings of industry would help in fitting graduates for team work and give them an idea of the significance of industrial work. It would also help them to acquire integrity and to take pride in their work, to increase their output and to raise their performance standards.

Since subsequent abandonment of the trade learned at vocational schools is frequently attributed to a desire for clean jobs which pay more, it was thought that industrial in-training might help to prepare and condition trainees for the type of work they are due to engage in.

It was suggested that the teaching staff of the vocational

schools should take refresher courses in industry in order to familiarize themselves with changes in machines, equipment and techniques and that engineers working in industry should be engaged as teachers or lecturers in the vocational schools.

Another suggestion was that in order to avoid an excess of "foremen" and "technicians", and not to cause future disappointment to trainees not suited for this type of work, a prior selection of vocational school applicants should be made so as to direct them to the type of school and course which would be best for them and for the industry. Such selection is becoming more and more indispensible under present conditions(29).

Some also ventured the opinion that quality was more important than quantity. The demand for greater familiarity with mechanized equipment also points in this direction. This trend also seems indicated in view of the rising cost of vocational training with increasing technological sophistication.

N. CONCLUSION

The survey has shown that there are two schools of thought in industry. While many of the subjects believe in giving vocational school students a broad, theoretical basis so that they may be able to adjust to the rapid technological changes expected in the future, others thought that more time should be spent in practical work with highly mechanized equipment.

Despite the apparent discrepancy between these views they are not necessarily opposed to each other. Some of the occupations mentioned in the survey require the kind of a practical background provided by a 2-year vocational school or industrial school, while others call for a broader theoretical background.

A very large number of subjects suggested the introduction of a "management and production" trend in the vocational training system. This raises the following questions:

1. Is it possible to predict that a boy of 15 or 16 has managerial or leadership qualities?
2. Is it desirable, at this age, to indoctrinate him with the idea that he is cut out for a "managerial position"?

While a large group of occupations (production technicians, foremen, technicians, and so on) requires some socio-economic knowledge which is best acquired at school, for other highly skilled trades technical ability is the principal requirement. Before it is decided

to open corresponding new trends, the extent to which success in each group of occupations can be predicted for young boys of vocational school age should be examined. The educational aspects of channelling boys into managerial and supervisory positions should also be considered. The literature seems to stress the need for recurrent training programmes at later periods[29]. It may be preferable to direct graduates to managerial courses only when they are older and have had some working experience and opportunities to test their vocational leadership qualities. A study carried out by the Szold Institute[2] has shown that in scholastic achievement there is no difference between graduates employed as skilled workers or as foremen and supervisors, so that presumably additional personality traits (such as "leadership qualities", "the capacity for human relationships", etc.) come into play. This matter should be thoroughly investigated.

From the recommendations made it may be concluded that vocational shcools should be diversified, so as to include additional "streams" and levels. For this purpose careful investigation of the curricula by vocational training experts is required with reference to the information so far gathered from industry and to additional information from other competent sources. A further conclusion is that a special effort should be made to develop certain personality traits in the students so that they may be able to adjust to the rapid changes expected in the future. The ways and means by which this may be done should now be investigated.

This pilot study was intended to channel information from industry to the authorities in charge of vocational education. The industrialists showed great knowledge of the subject and most of them were more than willing to express their views. However, the findings are by no means exhaustive and much further study is required. The rapidly developing electronics industry has not been sufficiently surveyed, and graduates who learned metal work at vocational school but work in other branches of industry were not included.

The survey is therefore regarded as a mere beginning. It is a step towards achieving a closer relationship between industry and vocational training which will undoubtedly be of considerable benefit to all concerned.

APPENDIX A

TABLE I.

Sample distribution by sub-branches and number of employees.

Sub-branch	20-40 employees	50-99 employees	100-299 employees	300+ employees	TOTAL
Basic metal industry	1	1	1	3	6
Industry of metal products	4	2	4	1	11
Machine industry	4	1	2	2	9
Electric and electronic quip. industry	2	1	3	2	8
Transport vehicle industry (excl. garages)	1	-	1	3	5
T O T A L	12	5	11	11	39

*The sample does not include army establishments and aviation industries.

APPENDIX A

TABLE II.

Establishments predicting future changes in the employment structure, sub-branch and size.

Sub-branch	Size of group 20-49	50-99	100-299	300+	TOTAL
Basic metal industry	1	-	1	2	4
Metal products industry	4	-	3	1	8
Machine industry	4	1	2	2	9
Electric and electronics industry	1	1	3	-	5
Transport vehicle industry (excl. garages)	-	-	-	3	3
T O T A L	10	2	9	8	29

APPENDIX B

TABLE I.

Percentage of skilled workers in production and maintenance (present and future).

Size of group / Sub-branch	20-49	50-99	100-299	300+
Basic metal industry				
Present	50	48	7	20
Future	60	*	8	20
Metal product industry				
Present	34	20	51	16
Future	38	*	39	16
Machine industry				
Present	19	72	33	37
Future	53	75	33	36
Electric & electronics industry				
Present	57	5	17	21
Future	91	10	17	*
Tranpost vehicle industry (excl. garages)				
Present	2	*	76	46
Future	*	*	*	28

* No information.

APPENDIX B

TABLE II.

Percentage of machine-setters in production and maintenance (present and future).

Sub-branch \ Size of group	20-49	50-99	100-299	300+
Basic metal industry				
Present	-	-	-	1
Future	-	*	-	-
Metal product industry				
Present	7	-	3	1
Future	7	*	7	1
Machine industry				
Present	2	-	1	-
Future	3	-	2	1
Electric and electronics industry				
Present	3	-	1	-
Future	-	-	1	*
Transport vehicle industry (excl. garages)				
Present	-	*	-	1
Future	*	*	*	-

* No information

\- No workers

APPENDIX B

TABLE III.

Percentage of technicians (mainly production technicians) and quality-controllers in production and maintenance (present and future).

Sub-branch / Size of group	20-49	50-99	100-299	300+
Basic metal industry				
Present	-	-	2	3
Future	-	*	2	6
Metal product industry				
Present	1	4	3	2
Future	1	*	4	2
Machine industry				
Present	6	-	4	4
Future	5	-	6	5
Electric & electronics industry				
Present	3	6	3	4
Future	3	3	4	*
Transport vehicle industry (excl. garages)				
Present	2	*	3	6
Future	*	*	*	4

* No information

\- No workers

APPENDIX B

TABLE IV.

Percentage of foremen and supervisors in production and maintenance (present & future)

Sub-branch \ Size of group	20-49	50-99	100-299	300+
Basic metal industry				
Present	10	8	6	4
Future	10	*	6	4
Metal product industry				
Present	7	10	4	1
Future	7	*	3	1
Machine industry				
Present	4	8	7	13
Future	3	9	6	11
Electric & electronic industry				
Present	11	11	4	5
Future	9	6	4	*
Transport vehicle industry (excl. garages)				
Present	5	*	5	5
Future	*	*	*	6

* No information

APPENDIX C

SPECIFICATION OF FUTURE OCCUPATIONS

1. Technicians.

Foundry technician.

Prepares vehicle for foundry kiln. Makes various quality-tests during and after production. Tests composition of casting granulated sand.

Aviation technician (engineering).

Plans auxiliary aviation installations for the construction or the improvement of aircraft body-parts which do not require detailed engineering; tests installations and issues instructions to fitters.

Production technician.

Takes orders for materials, receives raw materials from stores, assigns work for execution; checks on work-break periods; co-ordinates factors of production (auxiliary tools and instruments, the shift from one operation to another); reports to management on work progress.

Production process technician.

Determines work sequence, assesses time norms, determines work rotation on limited mechanical set-up.

Hydraulics technician.

Checks hydraulic instruments control devices, records their function, carried out repairs and improvements.

APPENDIX C cont'd.

Office equipment technician.

Traces defects and repairs modern office equipment (typewriters, adding machines, duplicating machines, etc.) and the mechanical parts of calculating machines and auxiliary equipment. Takes apart, services, repairs and re-assembles. Familiar with working principles of conventional equipment.

2. Instrument-operators.

Electromechanic instrument-operator.

Assembles electromechanic components (fine cog wheels, transducers, etc.). Checks electromechanical systems with mechanical and electric testing instruments. Checks the functioning of the systems.

Electronic laboratory technician.

Constructs circuits for electromechanic components. Calibrates instruments.

Electronics technician.

Constructs circuits for electromechanic components. Specifies procedure for construction of instruments.

3. Welfare.

Non-ferrous metal welder.

Performs welding operations with instruments using inert gas (argon, T.I.G. etc.). Familiar with welding control methods.

APPENDIX C cont'd.

Aluminium machine welder.

Sets and operates a stationary or mobile electric arc inert atmosphere welding machine, sets and regulates its controls, and regulates the transfer speed.

General metal worker - aluminium.

See general metal worker (assembly of aluminium and soft metals requires greater precision).

Ship piping assembler. 7-55140 (4)

Plans, constructs, assembles the piping systems in ships under construction or repair. Builds wire model of piping system. Assembles and checks finished work.

Ship plate assembler. 7-57.30 (4)

Moulds and fits steel plates in ships under construction or repair. Checks blueprints and specifications. Marks plates. Cuts, bends and drills or presses holes. Joins plates before welding.

4. Painters.

Expert painter.

Paints surfaces by brushing, spraying or dipping. Prepares colours and shades by mixing appropriate ingredients. Checks suitability and cleanliness of surface before painting.

Familiar with chemical composition of different paints and coatings including ingredients, characteristics of materials and

APPENDIX C cont'd.

testing and measuring methods. Experienced in the painting techniques, devices, and tools, including spray guns, electrostatic spraying, etc. Familiar with methods of preliminary surface cleaning.

Paint dipper.

Paints parts by dipping in enamel, lacquer and oil based paints or other liquids. May prepare surfaces for painting; prepares vats according to diagram. Is familiar with surface cleaning methods, dipping methods, testing of vats and coatings.

Coater.

Coats machine parts (e.g. electric motor parts) by dipping and baking in a kiln. Has same knowledge as a dipper and is familiar with methods of baking coatings, with kilns and with heat control devices, etc.

Spray painter.

Sprays decorative or protective materials such as paint, enamel or lacquer. Selects and mixes paints to order. May prepare surfaces for painting.

5. Miscellaneous.

Press operator.

Prepares and operates hydraulic extrusion presses for the production of seamless pipes, and poles of various diameters from hot metal. Checks blueprints and other data. Selects suitable dies,

APPENDIX C cont'd.

decides when to extract metal from kiln and submerge it into the tank. Determines various technical data.

Winder.

Winds wires of motor according to blueprints, for non-serial production.

APPENDIX D

RECOMMENDATION OF PREFERRED TYPES OF TRAINING FOR VARIOUS JOBS
(per cent)

Job title	1	2	3	4	5	6	7	8	9	10
Blacksmith, hammersmith, foregerman	9									
Furnaceman, annealer & Temperor (metals)	7									
Sheet-metal worker	20									
Welder	15									
Automechanic	8									
Construction metal worker	18									
General metal worker (welding, fitting)	41									
Mechanical metal-worker	24									
Die setter	11									
Set up man	7									
Lathe operator	29									
Foreman (or group inspector)	50									
Tool-maker (maintenance of tools, apparatus)	15									
Machine setter	7									
Tool-maker	12									
Electrician	24									
Mechanic (engine maintenance)	11									
Professional quality controller.	26									

APPENDIX D cont'd.

Job title	1	2	3	4	5	6	7	8	9	10
Production technician	29									
Engineer-technician	17									
Technician	13									
Technical clerk	16									

Legend

1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80%

* Generally the same as the number of plants in which the job exists.

1. Total No. of recommendations*
2. Advancement from another job)
3. Secondary School + adult training courses)
4. Vocational study programme in secondary school) Preferred
5. Technical School)
6. 4-year vocational school) training
7. 3-year vocational school)
8. 2-year vocational school)
9. Industrial school)
10. Apprenticeship)

APPENDIX E
QUESTIONNAIRE

The Szold Institute for Research in the Behavioral Sciences

The Ministry of Education & Culture
Department of Vocational Education

VOCATIONAL TRAINING AND INDUSTRIAL DEMANDS

Dear Sirs,

The Szold Institute for Research in the Behavioral Sciences, in cooperation with the Ministry of Education and Culture, is carrying out a study designed to gather information on present requirements for various industrial jobs, changes predicted in these jobs within the next ten years, and the abilities and vocational and general knowledge required for their performance. These data will assist in planning vocational and technical training in Israel.

The questionnaire is designed for persons in managerial positions in industry who deal with problems of production and skilled personnel. Information on a specific plan can be supplied by several engineers and/or managers of that plant.

We wish to stress that all information supplied by you will be treated confidentially and used exclusively by the Szold Institute for general tabulation. The summary of the findings will be published in such a manner, that none of the information can be identified with or attributed to any one plant.

I am certain that you will appreciate the importance of this study, and will contribute to its success by your early answer.

Thanking you in advance, I am,

Sincerely yours,

M. Avigad, Engineer
Director, Department of Vocational Education
Ministry of Education and Culture

APPENDIX E cont'd.

1. Name of plant, company (business) _____

2. Address of plant:

   city/settlement _____

   neighbourhood or industrial centre _____

   Street _____

   Number _____

   Telephone _____

3. Major products of the plant (in yearly sequence cycle).

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

4. Year plant began to operate _____ .

   a. Year plant began to operate at its present address 19____.

      If previously operated at a different address in Israel, please note same._____.

   b. Year plant began to operate at its first location in Israel 19____.

      If the plant previously operated outside Israel, please indicate____

   c. Year plant began to operate outside Israel _____.

APPENDIX E cont'd.

5. Type of ownership (please mark appropriate line with X).

a._____ Single owner.

b._____ Partnership.

c._____ Private limited liability company.

d._____ Public limited liability company.

e._____ Cooperative.

f._____ Government corporation.

g._____ Histadrut corporation.

h._____ Other. Please specify _____.

6. Number of workers employed.

a. Number of workers engaged in production (excluding engineers).

(Please differentiate between sales and administrative positions).

1. Production and maintenance workers _____

2. Technicians, quality controllers, clerks, foremen and general managers _____

3. Total _____

b. Number of employees working outside plant (excluding engineers).

1. In management, administration, sales and clerical work_____

2. In customer services _____

3. Total _____

c. Number of engineers in the firm

1. In managerial positions _____

2. In planning and development positions _____

APPENDIX E cont'd.

3. In sales positions _____

4. Others _____

5. Total _____

d. Remarks _____

_____

Questions to Table No. 1

Table No. 1 is to be filled out for all jobs in the plant (except engineers), i.e., group A in question No. 6, which at present or in the future require more than one year's training or a level of education equivalent to more than ten years' schooling.

7. Before you is a list of jobs, some of which exist in your plant, and some which do not. Mark existing jobs with X in column 3.
8. Add existing jobs which do not appear in the list, and mark them with X in column 3.
9. Some of the jobs listed are held by vocational school graduates. Next to each job note their number in column 4.
10. Considering the developments you foresee within the next 8-10 years, what jobs are likely to be added to existing jobs in the plant? Mark them with X in column 5. If they do not appear in the list, please add them and mark them with X in column 5.
11. Note the number of workers in each existing job in column 6.
12. Convert the production and maintenance workers into "number of workers in each job per 100 maintenance and production workers in the plant" and fill in the results in column 7.

APPENDIX E con'td.

13. Estimate the labour requirements for all existing and future jobs in your plant ten years hence. Note the figures in column 8. Next to jobs which will require no workers ten years hence, indicate —.

14. Convert numbers appearing in column 8 into "the future number of workers in each job per 100 production and maintenance workers, and fill in column 9.

15. There are various ways of training workers for jobs, such as: apprenticeship, industrial school, 2 year vocational school, 3-4 year vocational school, vocational programme in secondary school, on-the-job training. Columns 10-21 list various alternatives. Mark the alternative preferred by you for each existing or future job by an X in the appropriate column.

16. There are various streams in vocational schools such as metal-work, mechanical metal-work, tool-making, mechanics. The streams for all jobs for which you noted that technical or vocational school training was the preferred alternative (by marking columns 13, 14, 15, 16) are given in columns 22-35. Mark with an X the column headed by the stream which is suitable for training workers for existing or future jobs in your plant. If, in your opinion, streams should be added, please note them in column 35, next to the corresponding jobs.

Table No. 1

Code	Job Title	No. of workers in the job							Preferre					
					Present		Future							
		Exists at present	Vocational school graduates	Projected	Total	Per 100 production & maintenance workers	Total	Per 100 production & maintenance workers	Apprenticeship	Industrial school after elementary school	Industrial school after 2-year vocational school	2-year vocational school	3-year vocational school	4-year vocational school
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Foreman (or group inspector)													
	Professional quality controller													
	Production technician													
	Engineer - technician													
	Technician													
	Construction metal-worker													
	General metal-worker (welding, fitting)													
7-51	Mechanical metal-worker													
7-50	Lathe operator													
	Machine setter													
7-50.15	Die setter													
7-50.35	Set-up man													
7-41	Tool-maker (maintenance of tools, apparatus)													
7-34	Blacksmith, hammersmith, forgerman													
7-31.32	Furnaceman, annealer, and temperer (metals)													
7-50.20	Tool-maker													
7-50.25	Pattern-maker													
	Sheet metal worker													
	Welder													
	Iron welder													
	Non-ferrous metals welder													
	Electrician													
	Mechanic (engine maintenance)													
	Auto mechanic													
	Boiler man													
	Technical clerk													
Additional Jobs														

Table No. 1

Preferred Training	
11	elementary school
12	Industrial school after 2-vear vocational school
13	2-year vocational school
14	3-year vocational school
15	4-year vocational school
16	Technical school
17	Vocational study program in secondary school
18	2-year vocational school & in plant training
19	Secondary school & Adult training courses
20	Promotion through supplementary training
21	By other means
22	Mechanical metal work
23	Construction metal work
24	Fine mechanics
25	General mechanics
26	Automechanics
27	Electronics
28	Electricity
29	Tool-making
30	Refrigeration (air-conditioning)
31	Industrial lab technician
32	Industrial automation
33	Technical clerk
	Machine draftsmanship
	Other program, which?

APPENDIX E cont'd.

Questions to Table No. 2

17. In Column C of Table No. 2, give a concise description of the jobs which you added to the original list.

18. In Column D of Table No. 2, note the most important fields of knowledge in which workers should be trained for the jobs you added to the original list.

Table No. 2

A	B	C	D
The Job			
Number	Title	Description	Basic fields of knowledge or subjects of study

APPENDIX E cont'd.

Questions to Table No. 3

19. Before you is a list of five areas of study which are currently being taught in vocational schools, as well as a list of skills required of skilled workers. Based on your experience and impressions of the majority of vocational school graduates you have known, please note to what extent the vocational school has properly prepared its graduates in the areas of knowledge and skills set out in Table No. 3, for each of the following groups of occupations: 1) managerial positions 2) skilled workers 3) technicians.

Below are listed five levels of knowledge:

1. Extremely unsatisfactory
2. Unsatisfactory
3. Nearly unsatisfactory
4. Satisfactory
5. Most satisfactory

Please review these five levels and choose that which best expresses your impression of the majority of graduates you have met; note the number in the list and mark it in Table No. 3 in the square relating to each type of knowledge within each group of occupations.

APPENDIX E cont'd.

Table No. 3

Areas of knowledge, abilities and skills	Administrative and supervisory positions	Professional workers	Technicians	Specify areas of knowledge in which you think the graduates are poor
Number of graduates known to you				
Areas of knowledge				
1. Foreign languages				
2. Theoretical knowledge in science (mathematics, physics, chemistry				
3. a. Theoretical vocational knowledge. Example: mechanics, electricity, etc.				
b. Reading and understanding blueprints				
4. Practical vocational knowledge (practical work)				
5. Knowledge in production engineering. Example: cost accounting, industrial efficiency.				
Abilities and Skills				
1. Written expression				
2. Oral expression				
3. Self-expression				
4. Adjustment to change				
5. Thinking in economic terms				
6. Pride in physical work				
7. Responsibility				
8. Alertness				
9. Accuracy				
10.				

APPENDIX E cont'd.

20. From the list of subjects, abilities and skills given above, mark two which in your opinion will be of greater importance than the rest, considering the needs of your plant over the next ten years,

	for skilled workers	for managerial and supervisory jobs
Areas of knowledge		
Skills		

Which, in your opinion, will be less important, considering the need of your plant (note two!)

	for skilled workers	for managerial and supervisory jobs
Areas of knowledge		
Skills		

21. Do you think it advisable for engineers in your plant who fill the positions listed below to have a vocational school background? Mark the appropriate line.

A. General managerial positions yes____ no ____ Which background?

B. Technical managerial positions yes ___ no ____ Which background?

C. Planning & supervisory positions yes ___ no ____ Which background?

D. Sales positions yes ___ no ____ Which background?

22. In the past have vocational school graduates left jobs in your plant which require vocational training and moved on to jobs which have no connection with the trade they learned in school?

yes _____ no _____ I have no idea _____

APPENDIX E cont'd.

23. What, in your opinion, caused them to leave their trade? _____

_____

_____

24. What suggestions can you make to improve the present training given at vocational school so that its graduates should be better prepared for industrial requirements?

_____

_____

_____

_____

_____

_____

25. If any particulars which you consider necessary or important have been overlooked please add them here and explain your point of view.

_____

_____

_____

_____

_____

First and last name of person (or persons) filling in the questionnaire

_____

Position at the plant

_____

APPENDIX E cont'd.

The Szold Institute for Research
in the Behavioral Sciences.

The Ministry of Education & Culture.
Dept. of Vocational Education

Re: Survey on "Vocational training and industrial needs".

Dear Sir,

A few months ago you were interviewed by a research worker of the Szold Institute in a survey on "Vocational training and industrial needs". We appreciate your participation and we thank you for the information which you made available to us. We are now writing the final report, a copy of which will be sent to you.

We have tried within the scope of the subjects investigated to sum up the opinions of the persons interviewed regarding improvements in the training programmes of the vocational schools. Many have expressed the opinion that, "today's vocational schools overemphasize conventional craftsmanship whereas the graduates should be trained to use modern machinery, either in school workshops or in industry".

This recommendation will be inadequate unless it is accompanied by a list of machines and instruments which are currently operating in industry or likely to be introduced in the future, for which it would be advisable to train vocational school students.

We would be very grateful if you would let us have a detailed list of machines and instruments of this kind and send it to us on the attached sheet as soon as possible. A stamped and addressed envelope is enclosed.

Sincerely,

Rina Doron
Senior Investigator

APPENDIX E cont'd.

Name of plant _____

Name of subject _____

1. Machines and instruments currently operating in the plant for which, in your opinion, it would be advisable to train graduates during their vocational school studies.

_____

_____

_____

_____

_____

_____

_____

2. Machines and tools likely to be introduced in your plant during the next 8-10 years for which, in your opinion, it would be advisable to train graduates during their vocational school studies.

_____

_____

_____

_____

_____

_____

_____

Signature _____

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The following page numbers have been omitted due to a printing error: 7, 8, and 74.

No loss of contents has occurred.