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for

METAL PRODUCTION DEVELOPMENT UNITS (MPDU) */

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W O R K I N G P A P E R

METAL PRODUCTION DEVELOPMENT UNITS

S Y N O P S I S

This draft paper may be called a cover document for adapted technology studies made by Fiat Engineering for UNIDO.

These technology studies resulting in proposals for Adaptation of Modern Technology to Developing Countries are coined "Metal Production Development Units" (MPDU)

The purpose, of this document, is to bring forward the development aspect of these studies and to justify the technical assistance that will be required for implementation of these technologies in the form of MPDUs.

The paper should thus be useful for Governments to evaluate their interests and needs for a metal production development unit and for its inclusion in their national development plans.

Also for EEC, CID (ACP-EEC) and UNIDO the paper may serve to appreciate the need for assistance and the implementation consequences.

The above studies are based on a general evaluation of market potentials and overall conditions in African countries and will be followed by a Technical Implementation Plan (TIP) for each country that has earmarked an interest. The TIP will be based on a detailed survey in the specific country.

Metal Production Development Units

SUMMARY AND CONCLUSIONS

The metal working industry being the center-piece of any sophisticated industrialization deserves much more in-depth attention in developing countries.

For this reason it is suggested to establish Metal Production Development Units (MPDU), which eventually will provide most of the present severe needs for industrial infrastructure for this sector both in the form of production in-puts of parts as well as of service.

Two basic modules are proposed; 1) for casting and 2) for metal forming. Although the facilities suggested/to be installed, are in themselves adapted technology, they will be so modern as to provide the best quality of products. An even more important aspect of adaptation of technology is however integrated with these modules, namely the ability to create in the country itself appropriate technology through proper adaptation of tooling and re-design of products. This, at the same time, will create a multiplier effect by eventually making it possible for the respective countries to set up their own manufacturing plants with technology adapted by their own engineers.

The basic production units, i.e. cast iron foundry may also optionally include non-ferrous casting, and likewise metal stamping may include forging facilities however, what makes the proposals more comprehensive is the development of engineering groups and the establishment of precision workshops to supply tools and dies needed not only by the MPDU but also for industry in general.

The development of toolmakers, pattern makers, etc. may require 7 - 8 years of training and journeyman-ship before these people can work on their own. Similarly, it may take 5 - 7 years to groom graduate engineers to work without senior guidance. It will therefore take much technical assitance to develop these faculties, which is the reason why commercial ventures never attempt this in-depth development and therefore most often have a relatively small multiplier effect.

A technical assistance programme is therefore suggested for each MPDU to contain 15 man years of technical expertise and 96 man month of fellowship training abroad, at a total cost of approx. 4,2 million US $.

Based on the Fiat technical studies, capital investment proposals are 4.0 Mill. $ for the cast iron foundry MPDU, and 3,6 million $ for the stamping MPDU facilities. These amounts include extensive training facilities.

A simple viability analysis anticipating soft loans for equipment, technical assistance provided as grants and subsidies for local training costs may show production facilities to break even in the 3rd year of operation, however, to have the precision work facilities break even will take a little longer and take a major share of the technical assistance programme.

It is suggested to implement these facilities as business oriented ventures, although with Government control preferably also with strong ties to private industry in the respective countries.

It is evident that most of the African countries today will need such comprehensive manufacturing industries' infrastructure, that will support the development of existing and new industries not by competing with the industry it is to serve, but by providing products and services over and above the present level of capability of the sector.

Although costs in technical assistance funds may seem high and the development prospect somewhat long term, this is a type of project which will be a necessity for all developing countries, if they want to develop industries themselves and depend less on overseas' know-how and its lack of adaptation to their own country.

[illegible] MPDU [illegible]

To further the development of new and existing industries by providing essential industrial infrastructure in the form of:

- Production of quality parts and components for other manufacturers.

- Supply of tools, patterns, spares, essential repairs, etc. for the manufacturing industry.

- Provision of manufacturing engineering services to implement new product lines and new manufacturing plants.

- Special high-level training for precision workers and for manufacturing engineers initially for the MPDU itself, later to service the industry with high-level technical supervisory personnel.

Immediate objectives

1. Establish sophisticated facilities for training of precision workers and install actual production facilities for parts and components.

2. Undertake marketing research to establish a portfolio of essential buyers of products and engineering services and tools etc, and establish liaison with these same sources.

3. Undertake in-depth training of precision workers to do precision machining, tool making, pattern making etc.

4. Undertake on-the-job training of graduate engineers and technicians to develop their capability for design of tools, products and new manufacturing plants.

5. Manufacture actual tools and patterns for own production and for later sale to clients.

6. Train operators and in the second year of operation undertake actual production of components and sales of engineering services.

7. Particularly train counterpart trainers, foremen and engineers to later take over actual training and managerial functions and to do this partly by overseas fellowship training in specialized subjects.

8. Participate in and promote the establishment of joint ventures between overseas parties and local entrepreneurs, through technology screening and adaptation to local conditions including the provision of MPDU know-how and engineering to the extent it is developed, to substitute technology from abroad.

METAL PRODUCTION DEVELOPMENT UNITS (MPDU)

1.0 Background - Industrial Infrastructure

The metal working industry is the center piece of any sophisticated industrialization because it is the supplier of tools (plants) in their widest concepts to the whole manufacturing industry and at the same time the supplier of the most essential consumer durable goods and of capital goods in general.

But for the metal working industry to serve as the backbone of industrial infrastructure, the following facilities must be present

1) Specialized Technological Institutes in metal work
2) Tool, die and mould making factories
3) Manufacturing and product engineers
4) Parts manufacturers as suppliers to industries (e.g. foundry, stamping)
5) Stockist of parts for production and of tools and equipment.
6) Services to industry in machine tool repair, up grading of skilled workers e.g. to become technical supervisors, etc.

Although much effort has been spent in developing the metal working industry in developing countries, the core of this developmental problem, namely the facilities above, has most often only been attacked in a superficial manner by setting up general work shops and foundries - not able to provide qualified service for the manufacturing industry - but serving common maintenance needs only.

The result has been that most often all engineering is imported along with parts. If some parts are made locally, at least the tools are imported.

The purpose of this project is exactly to overcome these short-comings by creating basic metal working units which will provide not only inputs in the form of parts and components now imported to existing industries, but particularly assist in creating new industries, new product lines through engineering and tool making, and not the least by providing sophisticated maintenance and repair service to the manufacturing industry; and eventually also by supplying them the future technically oriented factory managers; - thus in fact providing most of the industrial infrastructure needed for the metal working industry - albeit in some areas on a limited and future basis.

Basic metal work

The basic metal work needed for all metal working industries next to the semi-prepared raw materials of plates, sheets and rods are

C A S T I N G and

M E T A L F O R M I N G

Through these two basic processes all specially formed parts and components are derived from iron and non-ferrous metal foundries, from sheet metal stamping and forming shops, from steel fabricating shops or from forging and hot stamping shops, and from machining shops.

Basic for all these forming processes are tools, moulds, dies, patterns, etc. that give the individual components their shape.

To create the designs for the patterns, dies, etc., highly experienced engineering talent is required and for the actual making of the tools superior craftmanship is needed in the form of tool makers and pattern makers.

Adapted technology

Sophistication in technology may increase quality of the product as well as reduce the labour consumption through mechanization and automation. Also the need for higher skills in the actual mass production is greatly reduced, however, often at a very severe cost in capital investment.

For developing countries it is essential to have quality of products at low capital investment and with more flexibility for adaption.

It is not possible either, to justify a high-level of mechanization or automation for very small volumes, relatively speaking, which prevail in developing countries.

To obtain product quality in low volume production it is necessary to have more skills in production and also to have the ability created to design and make the basic tools, dies, etc. because

1) Tools adapted to the requirements of developing countries are difficult to have made abroad, and they usually have to be specially fitted, requires reconditioning, sharpening, etc.

2) The making of these tools is very labour intensive and can eventually be made competitively in the developing countries.

3) Not the least - products can often be re-designed to accommodate far less capital intensive production.

Thus it is essential for the development of metal working industries to pay extraordinary attention to in-depth skill development and to engineering and not just think in terms of operator training.

The multiplier effect

Most metal working factories set up in developing countries are applying tools bought overseas along with product design. The factory has usually started out to make simple lines of products only requiring short term operator training, because many, if not all parts have been imported.

These productions have therefore rarely created any industrial development i.e. rarely multiplied, because there were no in-depth training of workers and no engineering capability developed.

In the developed countries, the faculties of engineering and tool making etc. come from various specialized companies. The multinationals, of course, have self-sufficiency in this respect. For developing countries it is rarely commercially justified to have a company that will be self-sufficient in these faculties, nor to have specialized companies providing these services. For this reason, the initial nucleus of such services must be provided from a central organization or unit, to which technical assistance has been provided to develop the skills, both in engineering and tool making and provide facilities for this training, which initially cannot be fully commercially exploited. First then, will a facility have been created that will have a multiplier effect and be able to assist existing industries in developing themselves and not the least create new industries and product lines.

However, most important, the presence of the MPDU will be essential infrastructure, making it interesting for and facilitating overseas investors in establishing themselves in the country. While the MPDU may at the same time assist the investor, it may also assist the Government in screening and adjusting proposals to contain the technology appropriate for the country in the metal working field.

A Modular Approach for Metal Production Development Units

To create all the basic faculties for development of metal work in one unit would be very costly and initially not always necessary because few countries would need or be able to utilize all the faculties, simultaneously.

For this reason, it is suggested to have at least two basic modules which are different, and to which optional modules can be attached.

The basic two modules are suggested to be

1) the cast iron foundry

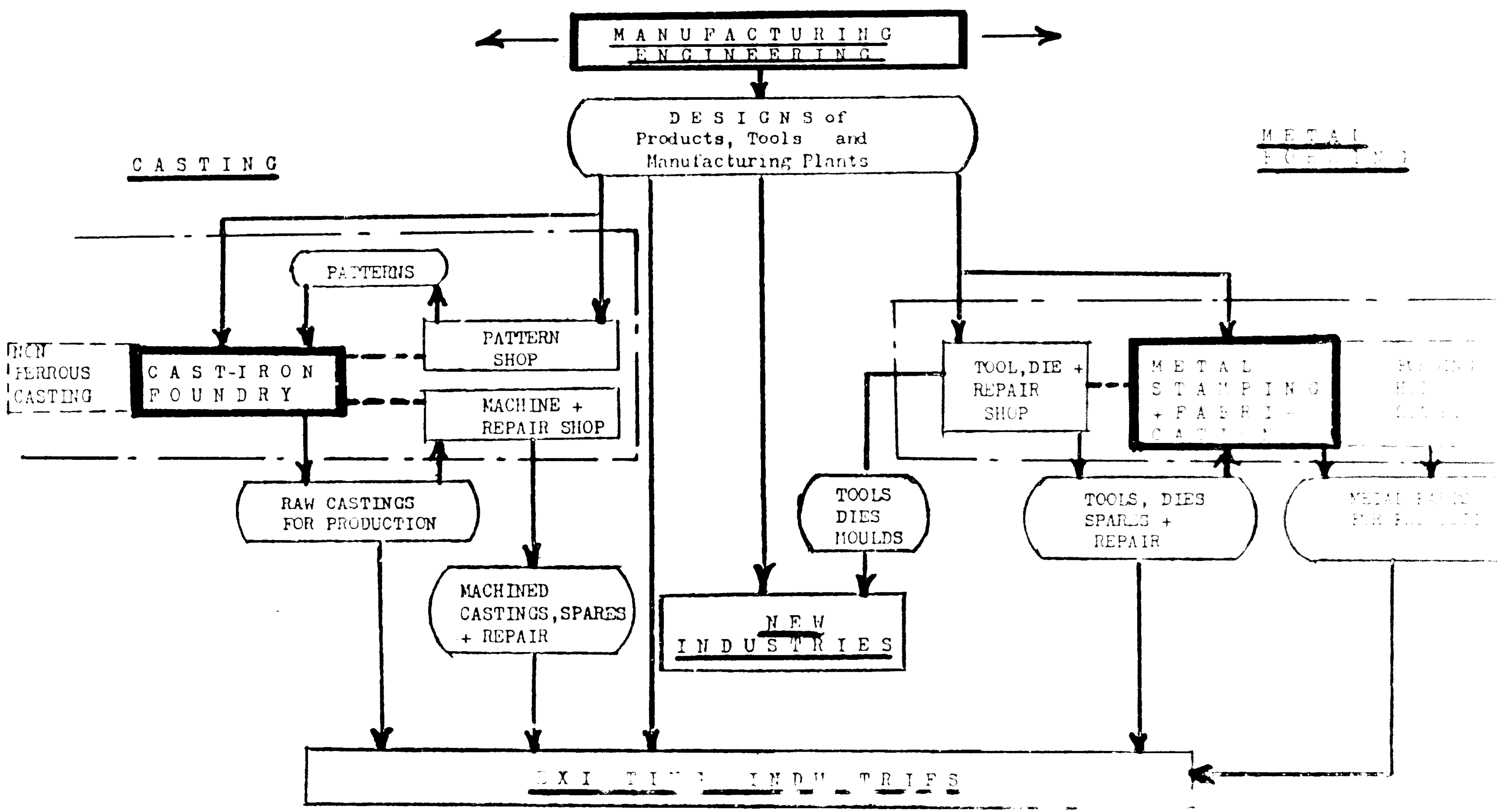
and

2) **the metal forming factory**

These are the two major inherently different specialities which by themselves often may be able to support a viable operation. It is further suggested that each of these two should have their special engineering department and precision workshops to feed in tools and to support the main operation; in the case of the foundry it would be a pattern shop and a machine shop to machine the castings and provide an in-depth maintenance and repair service; and in the case of a sheet metal factory it would be a tool and die making shop with sophisticated machine tools and equipment also to provide maintenance.

BASIC METALWORKING MODULES

and their relation to engineering



In both cases these basic units are suggested not only to support the industry with their productive output of quality parts and components, but also to provide essential services in manufacturing engineering and not the least in maintenance from developed auxiliary facilities. This will also create a better economic base for the MWM.
To the cast iron foundry may further be attached a non-ferrous metal casting facility and to the sheet metal factory a forging and hot stamping plant; - also steel casting could later be added to the foundry.
These additional manufacturing facilities may be justified, attached to the basic units but are difficult to justify on their own in developing countries except in extreme cases.

The production of parts

The main production should be parts, cast or stamped for other manufacturers not competing with them by making assembled products. The parts may be for the following product groups:

1- Agricultural implements.(Ploughs, carts, etc.)
2- Building components - metal.(Windows, hinges, locks, louvers)
3- Pots, pans, cookers, heaters etc.
4- Food process and other plants. (Beverage, meat-processors etc)
5- Drain, sewer and road fittings.(Signs, fencing, posts etc)
6- Railway, truck and hoisting equipment
7- Pumps, engines, brassware, - and eventually machine tools

The definition of basic Metal Working Units

UNIDO and Fiat Engineering have, through studies of the level of development on metal work in African countries and through technology studies, tried to define the above mentioned basic metal working units and their auxiliary facilities.

These studies have only been developed so far as to establish the basic technological principles in a plant layout to meet a generalized type of African market with products of either the cast type or sheet metal type - and have resulted in a general viability analysis.
This should be a sufficient basis for evaluation by countries and by finance and technical assistance institutions to get an indication of their interests and capability to assist in implementing the projects.

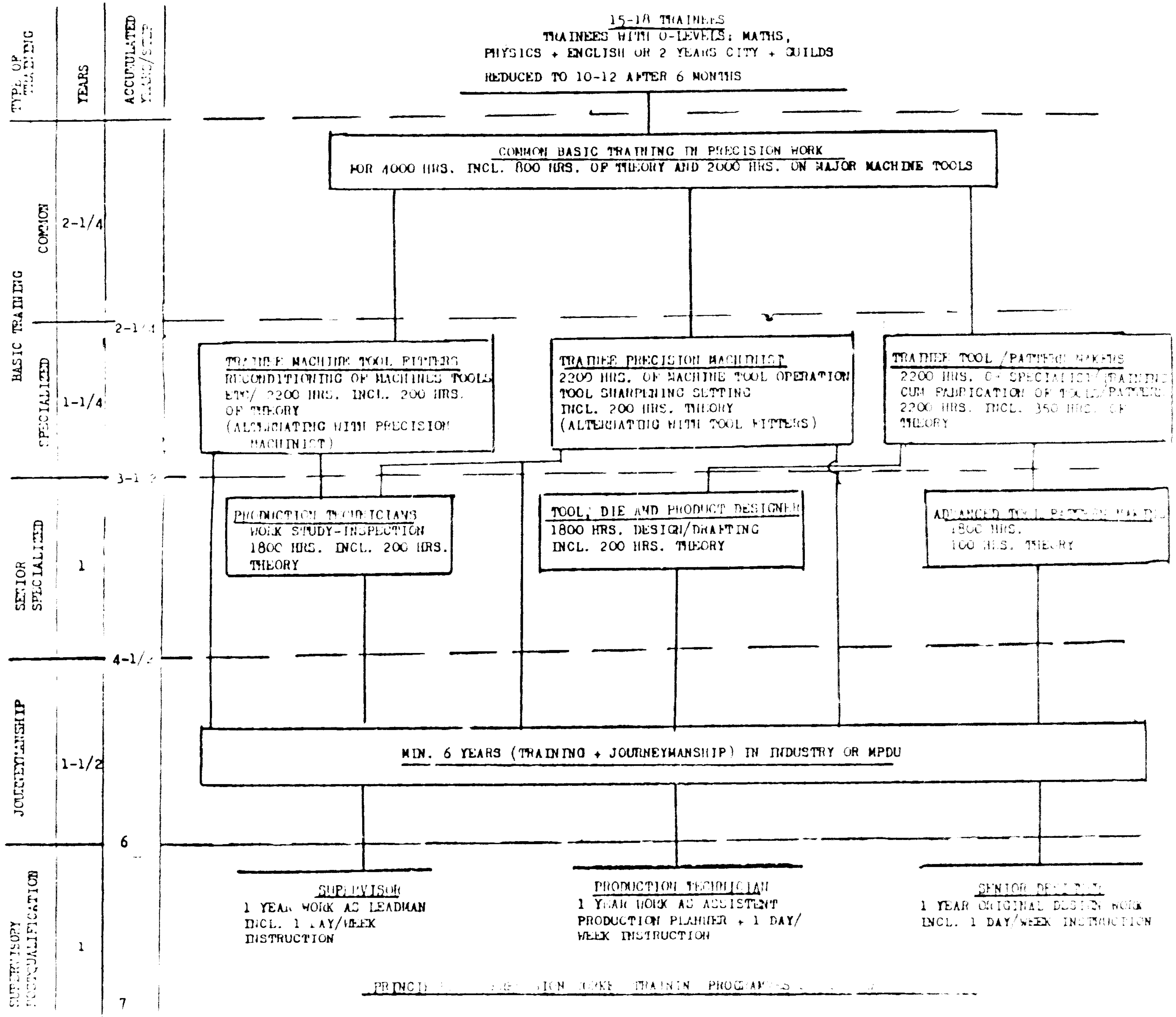
Justification [illegible]

It is impossible to think of implementing an MPDU as a purely commercial venture as it has been demonstrated that this will not serve any real industrial development. The in-depth skill development of tool and pattern makers and the development of manufacturing and product engineering capability is extremely costly, which is the reason why few investors in developing countries ever attempt this.

The development of these skills in the developed world is borne, in the first instant by technical institutions, but more so by the big companies employing trainee engineers and precision workers carrying them through an on-the-job training programme. This will be impossible in the developing countries, as there will be no properly equipped factories from which young engineers and precision workers can gain experience and get guidance from senior engineers and tool makers. The facilities to be created must therefore not only have workshops that are equipped for training and for actual fabrication of tools, patterns etc. but must also have experienced overseas staff that can provide the training and guidance both for the workshop as well as for the engineering department. The nature of work of a tool-maker or a pattern-maker demands seven to eight years of training before he can work completely on his own without guidance. Similarly, a manufacturing or product engineer is not of real value as an engineer before he has worked for at least five years as such under senior guidance. When its comes to specialities, it may take even more years e.g. to develop a tool designer. (See chart overleaf)

To start up the whole operation, it will also be beneficial to have local key engineers, foremen and managers go through a few months of familiarization training with companies in Europe; and later up-grading in specialized subjects (e.g. cast iron product design) may take place through short time i.e. four to six months in plant fellowship training.

It is suggested that the MPDU shall, for precision workers, provide the basic vocational training and for this reason must have subsidy not only in the form of supply of technical expertise and equipment but also to pay the maintenance allowances for trainees and future counterpart


TYPE OF TRAINING
YEARS
ACCUMULATED YEARS/STEP
15-18 TRAINEES
TRAINEES WITH O-LEVELS: MATHS, PHYSICS + ENGLISH OR 2 YEARS CITY + GUILDS
REDUCED TO 10-12 AFTER 6 MONTHS
BASIC TRAINING
COMMON
2-1/4
COMMON BASIC TRAINING IN PRECISION WORK
FOR 4000 HRS. INCL. 800 HRS. OF THEORY AND 2000 HRS. ON MAJOR MACHINE TOOLS
SPECIALIZED
1-1/4
TRAINEE MACHINE TOOL FITTERS
RECONDITIONING OF MACHINES TOOLS ETC/ 2200 HRS. INCL. 200 HRS. OF THEORY
(ALTERNATING WITH PRECISION MACHINIST)
TRAINEE PRECISION MACHINIST
2200 HRS. OF MACHINE TOOL OPERATION TOOL SHARPENING SETTING INCL. 200 HRS. THEORY
(ALTERNATING WITH TOOL FITTERS)
TRAINEE TOOL /PATTERN MAKERS
2200 HRS. OF SPECIALIST TRAINING CUM FABRICATION OF TOOLS/PATTERNS
2200 HRS. INCL. 350 HRS. OF THEORY
3-1/2
SENIOR SPECIALIZED
1
PRODUCTION TECHNICIANS
WORK STUDY-INSPECTION
1800 HRS. INCL. 200 HRS. THEORY
TOOL, DIE AND PRODUCT DESIGNER
1800 HRS. DESIGN/DRAFTING
INCL. 200 HRS. THEORY
ADVANCED TOOL PATTERN MAKERS
1800 HRS.
100 HRS. THEORY
4-1/2
JOURNEYMANSHIP
1-1/2
MIN. 6 YEARS (TRAINING + JOURNEYMANSHIP) IN INDUSTRY OR MPDU
6
SUPERVISORY POSTQUALIFICATION
1
SUPERVISOR
1 YEAR WORK AS LEADMAN INCL. 1 DAY/WEEK INSTRUCTION
PRODUCTION TECHNICIAN
1 YEAR WORK AS ASSISTENT PRODUCTION PLANNER + 1 DAY/ WEEK INSTRUCTION
SENIOR DESIGNER
1 YEAR ORIGINAL DESIGN WORK INCL. 1 DAY/WEEK INSTRUCTION
7
PRINCI ... ION WORK TRAININ PROGRAM...

instructors. It is not realistic to think in terms of upgrading already trained machinists to become precision workers as the discipline for precision work has to be indoctrinated early.

As the MPDU will initially not have a developed market, it must be anticipated that even the production aspect of the units will develop gradually. In particular marketing activity along with engineering will be essential to create future production volume, by assisting new industry in being established to use the output of the MPDUs Simultaneously also the tools and patterns may be designed by the engineers and made by the tool and pattern makers. Thus the initial period will be training and production implementation while opening and developing markets.

To finance this initial period of pre-operational costs the local government may be expected to participate, however these costs are of such a nature that they should also justify soft loans for capital investments if not grant e.g. for training equipment.

Activities and output

1. Marketing and manufacturing engineering

Identify production possibilities for cast components and for forged or for sheet metal components.

Techno-economic analysis for new industrial ventures, that may be future users of the output of the MPDU including the screening of technology transfer proposals, license negotiations, undertaking viability analysis, etc.

Design of tools, patterns etc. as may be needed by the MPDU itself and by industrial clients.

2. Production

In the second year of operation start actual production of parts and components for the industry with the object of obtaining full production after four years in one shift.

3. Training

Take-in 15 precision worker trainees per year and expect an output 4-5 years later of journeymen, toolmakers, patternmakers etc. in numbers of 10 per year. - Some may later become trainers, technicians and designer draftsmen.

Train production workers, machine tool operators, moulders, casting and melting operators etc. for two to three years to enable them to work as specialized workers with only supervisory guidance.

Training of counterpart trainers and foremen in numbers of two to each expert earmarked for the project.

On-the-job-training of engineers, who after five years may attain enough capability to operate on their own a limited scale, having been trained by engineering experts in numbers of two per expert.

4. Long-term multiplier effect

As a function of training eventually supply factory managers and technical supervisors to other companies.

On the basis of studies made by the engineering department, establishment of subsidiary companies with participation of the NPDU itself, as well as of private industries and overseas investors who may be partly supplying overseas market outlets and know-how.

Inputs

1. Capital costs

These are suggested to be financed as follows:

(i) Buildings through government or equity funding, locally;

(ii) Equipment through soft loans at least for training, possibly commercial e.g. from equipment supplier country, local finance institutions.

2. Training assistance

Local training cost in the form of maintenance allowances for trainees and trainer/instructor cost, to be subsidized by the Government. Technical overseas experts are suggested to be financed either through EEC or bilateral funds, the same for fellowship training abroad.

3. Pre-operational costs and working capital

Basic working capital to be financed also by soft loans. On top of this may be needed funds to cover the initial pre-operational costs which may either be taken up by the shareholdings, expecting these to eventually become profitable, or by the Government or overseas grants.

4. Promotional costs

Also promotional capital may be needed for local entrepreneurs to take an interest in utilizing the engineering services of the MPDU, e.g. calling it an industrial upgrading fund or product development fund or pre-investment fund to be financed by the Government plus possibly by overseas aid, - to encourage small entrepreneurs to buy engineering services from the MPDU.

Work plan

The attached work plan is generalized for the two basic MPDUs (casting and stamping) and shows the initiation of the major activities. A more detailed work plan will be made for each of the MPDUs in the technical implementation plan or final project document.

Implementation requirements for effective participation of the industry

It is anticipated that an MPDU eventally should become economically self-sustaining. It is therefore essential that the MPDU is tied in with the commercial world in the specific country in question.

It will be important for the MPDU to be able to sell its services and components through the existing trade channels and distribution systems.

In this context it will also be an advantage that the MPDU produces products and components with brand names or with qualities accepted in the countries in question. It is thus necessary to have either agreements or ties to the local manufacturers who may be potential buyers of the company's future products and services.

Regarding the MPDU itself, it may not be of interest, nor be beneficial for the developing country itself to have overseas investment participation, maybe directing the MPDUs efforts more commercially, than from a development point is desirable.

As however one of the essential aspects of the engineering part of the company will be to create a basis for new industries, it may for the latter be important not only to have local investors but also overseas participation, e.g. to provide markets or to provide parts of the technical know-how that the country or the MPDU still will be too young to create itself.

WORK PLAN MPDU

	Year 0	Year 1	Year 2	Year 3	Year 4	Year -
1. Preparatory Project						
Provide finance						
Recruitment of initial staff						
Introductory fellowships (10-12)						
Tender of equipment						
Start building construction						
Market research/Site selection						
2. Training						
Training for precision workers 15/year (10 net)		Start of groups of 10-15				
Operator training (10-15/year)						
Engineering on the job training 6 in first year, 2/year thereafter						
Training of counterpart trainer/ foremen (initial intake 10-12 plus 2/year)						
Inplant upgrading of engineers (fellowships) 6 x 4 months						
Inplant upgrading of counter-part trainers (fellowship) 6 x 4 months						
3. Engineering						
Market research						
Product and tool/pattern design						
New manufacturing plant design						
4. Production						
Parts and components for sale						
Initial tools/patterns for own use						
Initial tools/patterns for sale						
Repair service						

Organizational Framework

It will be advantageous for this type of operation that it is operated in the same manner as the industry it is going to serve, i.e. as a business.

There is a large training component in the proposal, and training of this nature is most efficient, when it is undertaken in a business environment with actual production activities available for training exercises. However, it is essential to assure a proper training activity, i.e. development aspect being controlled through government participation and not sub[illegible]ted to business pressure only.

The following possibilities of an organizational framework may be contemplated:

1. An institution, Government funded;
2. A private company, totally Government owned, but operated as a business;
3. A private company, Government controlled, but with share participation from industry, preferably its future potential buyers of products and services;
4. Separation into two parts, one part which is institutional and undertakes initial basic training and another part which is entirely the business aspect, which may then be operated as 2. or 3. above;
5. A co-operative in specific countries.

The experience with Government institutions for this type of operation points towards low efficiency; such institutions are also subject to Government regulations that may not make it possible to retain the best people or may require shorter working hours then customary for business and may in fact, in general hamper an efficient development, if not for other reasons, by the negative attitude that private industry often has towards Government business.

Solution 3, therefore seems the best solution, because a private company operating as a business with private participants would this way be able to secure its future revenue partly through its shareholders. Also participation from these industries on the Board of the company, could provide inputs which could be beneficial for the company's development

On the other hand, the controlling Government shareholding would ensure that technical assistance programmes, and training subsidy provided by Government was spent in a fashion to secure in-depth development rather than having the benefits going only to the pockets of industrial participants. It is not suggested that one should present "Package" to these participants, which is overly profitable as their interest in investing should rather come from an interest in the development of their country and in securing their own future supplies of components, tools etc.

Solution 4, is of course a feasible one, but precision worker training must earliest possible be on actual production jobs and under business pressure to develop efficiency.

The type of operation described under (3) has been tried by UNIDO and proven itself to be successful as long as Government is prepared to leave the control of the company to its board and prepared to provide the necessary training subsidies.

CAPITAL AND ASSISTANCE REQUIREMENTS

Viability Analysis

The estimates for capital requirements are based on a number of generalized conditions e.g. cost of building a factory shell: 150 $/ sq.m. excluding installations - and not the least on the availability of a market of common African type sufficient to cover the minimum of scale, adapted plants suggested.

(000 $US)

Capital requirements	Foundry Cast iron 5,800 sq.m.	Extra Non-Ferrous	Stamping 3,300 sq.m.	Extra Forg[illegible]
Buildings	1,000	-	600	-
Equipment - Including Installations	3,110	140	3,000	51[illegible]
Total:	4,110	140	3,600	51[illegible]

As the non-ferrous casting addition may comparatively easy be justified initially, the total foundry cost will be (excl. land):4.0 million $. To include forging with stamping will however require special market conditions to become viable and is therefore not included initially givin[illegible] an investment for stamping including tool-making of 3.6 million $.

This capital is suggested to be financed as follows:
The building costs from local funds;
Equipment costs from soft loans.

A training subsidy is suggested to be paid by local government to cover trainee maintenance allowance and counterpart instructor salaries for engineers and technicians in their first year only.
The local training subsidy costs may amount to 0.6 - 0.8 million $ over a five year period.
Pre-operational expenses of the order of 100 - 200,000 $ may also be expected to be paid by government i.e. local personnel cost in the year of construction/introductory training.

Technical assistance

The technical assistance requirement is detailed overleaf and consists of managers, tool making instructors and engineering/marketing experts who wi[illegible] initially perform as general managers, shop managers, etc. This programme suggested to cost a total of 3.7 million for each project. This will [illegible] five year programme plus an initial preparatory project of one year.

Overseas Fellowship training for engineers, technicians and foremen is suggested over a 5 year period to total 312,000 $ for each project or total technical assistance cost for each project of approx. 4.2 million US $.

TECHNICAL ASSISTANCE PROGRAM - MPDU (FOUNDRY)

Expertise Required	Duration	Application in year (costs thousands $)					Approx Total cost 000
		1	2	3	4	5	
Project Manager - 3 first years acting General Manager	5 years	80	90	90	100	100	460
Foundry shop Manager/Trainer	4 years	40	80	80	90	45	335
Moulding Trainer	3 years	35	70	80	40		225
Melt and Casting Trainer	3 years	35	70	80	40		225
Machine Tool Operator Trainer	3 years	35	70	80	40		225
Machine Tool Mechanic Trainer	4 years		70	80	80	80	310
Pattern Maker Trainer	5 years	70	80	80	80	80	3[illegible]0
Foundery Plant Engineer Expert	3 years	70	80	80			230
Cast Iron Design Engineer	4 years		80	80	90	90	340
Industrial Engineer/ economist	3 years	35	80	80	40		235
Metallurgist	2 years		80	80			160
Marketing Engineer	2 years	70	80				150
Short term (4-6 months each) Specialist Engineering Experts - e.g. Brassware, Special Product Design and Plant Design, etc	4 man years		20	80	80	150	330
Preparatory Project In Year 0 (Equipment purchasing - local building activity - recruitment, etc.)							150
Total Technical Manpower Assistance	45 man years	470	950	970	680	545	3.[illegible]65

If a tool making capability is to be developed alongside the above it would require another 8 years of workshop experts and 8 years Engineering experts.

TECHNICAL ASSISTANCE PROGRAM – MPDU (SHEET METAL)

Expertise Required	Duration	Application in year (costs thousands $)					Approx Total cost 000$
		1	2	3	4	5	
Project Manager - 3 first years acting General Manager	5 years	80	90	90	100	100	460
Chief Workshop Trainer/Manager	4 years	35	80	80	90	45	330
Sheet metal Plant Engineer	2 years	70	80				150
Sheet Metalwork Trainer	3 years	30	70	70	40		210
Precision Worker/Toolmaker Trainer I	3 years	30	70	70	40		210
Precision Worker/Toolmaker Trainer II	3 years		70	70	80		220
Precision Worker/Toolmaker Trainer III	3 years		35	70	80	40	225
Precision (Machine tool) Mechanic Instructer	3 years			80	90	90	[illegible]
Sheet metal Product Designer	3 years	35	80	80	45		240
Tool and Die Designer I	3 years	35	80	80	45		240
Tool and Die Designer II	3 years		40	80	90	45	255
Industrial Engineer/Economist	3 years	35	80	80	45		240
Marketing Engineer	2 years	70	81				151
Short term (4-6 months) Engineering Experts - e.g. Quality control, Heat treatment, Specialist Plant or Tool Design 5 man years	5 years		40	120	135	135	430
Preparatory project in year 0 (Equipment purchasing, local construction activity, recruitment, etc.)							150
Total Technical Manpower Assistance	45 man years	420	896	970	880	455	3771

Simple Viability Analysis

Based on in-put figures from the Fiat basic technology study, some preliminary analysis are shown overleaf for the:

1) cast iron foundry including machine shop and engineering,
2) tool making (precision worker) services (essential part of sheet metal plant), including engineering,
3) Sheet metal forming production.

The figures are summarized from the Fiat study.
The first one shows how a production unit only, will break even more easily and with less technical expertise (see technical assistance experts foundry) - however the border-line economy of scale unit will of course be extremely sensitive to obtainable market prices, which are estimated to be 30% above European ex-factory prices, to take into account the usually much higher prices obtainable in these countries because of duty, import license requirements, transport costs, convenience, etc. It also anticipated that local costs of materials, utilities, etc. are higher than those in Europe.

The analysis for tool making show how essential interest free loan and technical assistance will be for training precision workers as they only very showly become productive.

For sheet metal production, one can see a similar development as for foundry - however, somewhat slower due to the money and time requirements for tools being much greater, than for patterns for foundry. With only a generalized market study, it is difficult at this stage to produce a more convincing viability analysis for sheet metal parts; for engineering there is fortunately no capital investment charges other than buildings. Thus with technical guidance from senior expert engineers they are after one year grooming, usually able to earn their salary in sales or provision of Engineering Services - and should after 4 - 5 years be able to provide a revenue of 2 - 3 times their salary, then being able to contribute directly to cover overhead.

SIMPLE VIABILITY ANALYSIS

For Foundry M P D U

000's

	1 Year	2 Year	3 Year	4 Year	5 Year
INCOME					
Sale of Products (castings)		696	1406	1812	2097
Workshop and Engineering services	13	69	176	331	409
Training Subsidy	225	149	66	72	88
Total Revenue	238	914	1648	2215	2594
COST					
Operating Cost	245	715	924	1199	1370
Interests + Depreciation	258	300	335	583	583
Total Costs	503	1015	1259	1782	1953
PROFIT/(Loss)	(265)	(101)	389	433	641
CASH RESULT (Add back depreciation)	(49)	157	682	774	982
Depreciation Charges	216	258	293	341	341

SIMPLE VIABILITY ANALYSIS

For Precision Workshop (Toolmaking) and Engineering

NET INCOME STATEMENT AND CASH RESULT

000'$

	1 Year	2 Year	3 Year	4 Year	5 Year
INCOME					
Sales of Workshop services and of Engineering Services		86,4	226,8	432	702
Training Subsidy	73,5	49,5	50	57,5	66
TOTAL INCOME	73,5	135,9	276,8	489,5	768
COSTS					
Operating costs	96	163	238	336	454
Depreciation charges	53,3	103,3	143,3	164,3	172,8
Loan Interest (10 years grace, 40 years payback) 1%	15	30	30	30	30
TOTAL COSTS	164,3	296,3	411,3	530,3	656,8
PROFIT/(Loss)	(90,8)	(160,4)	(134,5)	(40,8)	111,2
CASH RESULT	(37,5)	(57,1)	8,8	123,5	284

SIMPLE VIABILITY ANALYSIS

For Sheet Metal Production

000'$

	1 Year	2 Year	3 Year	4 Year	5 Year
INCOME					
Sales of Products		205	678	1281	1753
Training Subsidy	23,5	32,1	32,8	22,5	30
TOTAL INCOME	23,5	237,1	710,8	1303,5	1783
COSTS					
Operating costs	56	213	610	1043	1307
Depreciation charges	26	47	80	114	137
Loan Interest (10 years grace, 40 years payback) 1%	12	25	25	25	25
TOTAL COSTS	94	285	715	1182	1469
PROFIT/(Loss)	(70,5)	(47,9)	(4,2)	(121,5)	314
CASH RESULT	(44,5)	(0,9)	75,8	235,5	280

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