K B Pumps©

It is a matter of investment. But how much to invest is the problem that bothers Mr. Srivatsa, the Managing Director of K.B. pumps, the most. Mr. Athreya, the Director, technical insists on a Rs. 111.2 Millions investment. He has even threatened to resign if this proposal is not taken up. On the other hand, Mr. Bharadwaj, Director, Finance, believes that the investment has very poor pay back and the IRR and is suicidal. Instead, he recommends a Rs. 45.54 Millions investment. Srivatsa has called both of them for a meeting on June 20, 1997, to re-examine the two proposals in a little more detail.

The company background

K B Pumps was incorporated as a private limited company in April, 1960 and later converted into a public limited company in March 1967. The company is engaged in the manufacture and sale of power driven process pumps for use in the fertiliser, chemical and petro-chemical industries. They have their plants at Pune, Ahmednagar, and Coimbatore. The company is known for its high quality standards. It keeps a strong check on quality right from the raw material stage. It has it's own grey iron and alloy foundry at Ahmednagar. Since castings form a critical part of pumps, it was necessary to have total control on their quality. In 1979, the company introduced the mobile fire fighting pump sets, which was well received in the market. The company enjoys a good reputation for product quality and after sales service.

Industry Background

Pumps form an important segment of the engineering industry. Any industry that uses fluids in its processes, find pumps essential, especially when fluids have to be transported or delivered over a distance or height. Since almost every industry uses some fluid or other, the pumps form a vital component of the process. According to an industrial survey, there are 70 units in the organised sector. There are more than 500 small-scale units manufacturing pumps, most of them meeting the requirements of the agricultural segment.

The Indian pump industry manufactures centrifugal pumps, submersible pumps, screw pumps and slurry pumps. With industrialisation, there has been a huge demand for process pumps especially of special applications in industries such as chemicals, fertilisers, oil exploration, and refineries. The market for pumps does see competition

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at the lower end from small-scale industries. Large manufactures such as K B pumps have carved out special niches for themselves.

The future of this industry is directly linked to the rate of growth of industrial activity in the country. With the current pace of growth there should be no dearth of demand, the only concern is that new entrants and easy availability of technology will probably tell on profit margins. Moreover, frequent changes in design incorporating better features, improved operating range and efficiency, and numerous varieties of each type of pump makes it look as though many hundred different products are being manufactured at any point in time. Going by the current market trend, only those who keep introducing more sophisticated models are likely to enjoy an edge over others.

Manufacture of new components

The decision to manufacture and market certain critical components for the high efficiency submersible pumps was taken as a result of the business strategy exercise carried out six months back. There are only two companies engaged in the manufacture of these components. One of them has problems with respect to quality and is not able to meet committed delivery schedules. The other one has a good technological base but is ridden with labour problems. The company felt that the time was ripe for making an entry and identified the wide gap that existed between the supply and demand of these components. Further the market for high efficiency submersible pumps is in the growth stage. This would mean more sales in the coming years once the manufacturing stabilises.

The company has recognised that low cost competition may be appropriate for mature products and technologies. For products in the earlier stages of their life cycles, a company's manufacturing performance may be best measured by its ability to employ technological innovations and incorporate advanced features with its new products. A low cost plant for a new product may lead to product failure if the low cost is achieved by sacrificing flexibility, adaptability, delivery schedules and quality.

The system will machine components for a family of four pumps averaging 76x76x114 cm in size and 1133 Kgs in weight, with 140 machined surfaces. Initially, 225 different variations will have to be manufactured. It is expected that four more family of pumps will be added in the next two years, when the number of varieties will swell to around 400. For the first two years, whatever is manufactured will be sold since no new entrants are expected. At an average price of Rs. 11,000 per unit the projected annual sales is expected to be around 6000 units. However, in future, more effort may be required to increase the market share.

The company does not have adequate built floor space in its existing manufacturing location to house this new investment. However, it has open space at a nearby location in Ahmednagar, where it plans to create the necessary infrastructure by adding the required buildings. Although the company has been continuously reducing the labour force in its existing manufacturing facilities, it did not consider it prudent to relocate employees from other units to this new facility. Hence the manpower requirements for this new proposal will be entirely met with new recruitment. Two proposals were made with respect to the new investment.

Proposal A

In one method, the conventional special purpose machines, and a few NC machines could be used in a stand-alone fashion. This approach would require a total of 28 machines. The estimated space requirements is about 1,80,000 sq. ft. The manufacturing cycle time will be about 16 days. Production capacity will be limited to 7000 per year. It is expected to run two shifts daily.

The system could be designed to handle a limited variation of a particular component. Of the 225 different varieties, less than 5% could be machined without significant production interruptions and another 20% could be machined with a changeover time of less than a shift. The rest of them may require detailed machine and tool setting. This would require a set-up time ranging anywhere between one and four shifts. Some more details on the proposal are available in Exhibit I.

Proposal B

There is an alternative proposal for the manufacture of these components using a flexible manufacturing system (FMS). The FMS consists of nine machines. The material handling system consists of three AGVs. There will be a DEC/VAX mainframe computer and six workstations, which are networked to the mainframe computer. Together these will form the control system. All the software will have to be tailor made for the project. This would entail some cost and time overruns.

The FMS will be initially designed to operate with a capacity to produce 6500 components annually, but it can be ultimately expanded by 60%. The space requirements of the FMS are one third of the conventional system. The manufacturing cycle time of FMS will be less than the conventional system by about 70%. Due to these, the WIP and finished goods inventory requirements are less compared to the conventional stand-alone system.

Detailed information about the two proposals is available in Exhibits 1 to 3. The software costs, training costs and the cost of the material handling system and the machining system are much higher for the FMS (see Table 1). The operating parameters for the two systems are given in Table 2. FMS requires less floor space, demands less investment in inventory and require less labour. The quality levels (measured as the percentage of the cost of the goods manufactured) are better with the FMS. However the initial investment in the system is very high compared to proposal A.

The meeting

The Director (Finance), Mr. Bharadwaj had a meeting with the Director (Technical), Mr. Athreya.

Bharadwaj: Our senior manager, Finance has got the two proposals evaluated. The proposal of employing special purpose and NC stand-alone machines appears to be attractive. The FMS proposal fetches a poor pay back period compared to other proposal. You may be aware that our current policy is to select projects that have pay back periods less than 4 years. Moreover, the IRR for FMS is also very low compared to the stand-alone NC machines system.

Athreya : I am not convinced that one can use pay back periods as a criterion for investment justification especially in the case of a computerised manufacturing system. Moreover, the use of IRR as a measure is also not clear to me. But that is only one of the points of my concern. I do not understand how you can get a high IRR for the NC proposal and a low figure for the FMS proposal. Could you explain how you obtained these values?

Bharadwaj: Oh! certainly, that is not a problem for me. Mr. Kausik, our senior manager finance, prepared the workings. He should be able to explain it better. Mr Kausik would you please explain how you went about this exercise?

Kausik : You see, we know the level of investments for the two proposals. Our marketing department has forecasted a annual sales of about Rs. 66 millions. The manpower requirements for the two proposals are available and the cost of goods manufactured can be computed using the data in tables 1 and 2. Using this the initial, the terminal and the annual cash flows are obtained and finally the IRR is computed. As you can see, the investment in FMS (Rs. 111.2 Millions) is more than double the investment in the standalone NC machines system. Naturally you would expect a very low IRR.

Athreya : No Mr. Bharadwaj, I am not convinced of this. I think we have not included the benefits that we may obtain from using FMS.

Bharadwaj: I do agree that these all have a value, but how can that be expressed in financial terms at the outset of an investment, which may be one of the most radical that the company has undertaken?

Athreya : Do you mean to say that because the new key elements of competitiveness, quality, life cycle costs, JIT delivery, and the ability to change product rapidly are considered intangibles and do not quantify easily, they can be ignored by traditional accounting practices. In fact, I feel that even those benefits, which are in principle quantifiable cannot be quantified with much precision due to lack of experience with the new technology. With the result, the degree of uncertainty attaching to cash flow forecasts for new technology investments is much greater than that associated with say the purchase of a replacement machine of a well known type for use in an established product. This will be the problem that you will face with all the investments in the area of new technology such as FMS. How do you propose to tackle this problem?

Bharadwaj: I can request Mr. Kaushik to sit with you and work out means of incorporating these issues in investment justification. I expect this to be a difficult task. With all these, Mr. Athreya, my apprehensions are that the IRR for the FMS proposal will not rise to 15% or more, in order for us to clear the proposal.

Athreya : This is another issue which I wanted to raise last time itself, when we were evaluating the proposals for modernisation of the Material Handling system for the Coimbatore unit. We struck down one proposal because it had only a 11.5 % IRR, although in my opinion that particular proposal was the most suitable and futuristic. Why should we use a 15% hurdle rate? Is it not too high and restrictive? On what basis do you arrive at this number?

The apparent inability of traditional models of financial analysis such as discounted cash flow (DCF) to justify investments in computer-integrated manufacturing is obvious. I propose to abandon such criteria for CIM related investments. Let's be more practical. DCF is not the only gospel. Many managers have become too absorbed with DCF to the extent that practical strategic directional considerations have been over looked. Beyond all else, I have come to believe that capital investment represents an act of faith.

At the strategic level, it may not be simply a question of calculating a return on capital employed. Competitor's action may be the vital factor. Every company will need to reassess it's ability to compete. Should we not consider these factors, while evaluating both the proposals before taking a final decision?

Bharadwaj: I do not see eye to eye with you in the matter of using DCF technique for investment justification. To me it sounds unlikely that the theory of discounting future cash flow is either faulty or unimportant. Receiving Rs. 1 million in the future is worth less than receiving Rs. 1 million today. Successful process improvements must yield returns in excess of the cost of capital invested. That is only common sense. If a company even for good strategic reasons, consistently invests in projects whose financial returns are below it's cost of capital, it will be on the road to insolvency. Whatever the special values of FMS technology, they cannot reverse the logic of the time value of the money. My viewpoint is that managers need not and should not abandon the effort to justify CIM on financial grounds.

Bharadwaj appraised Srivatsa of the inconclusive nature of his meeting with Athreya. Srivatsa realised that this is just the beginning of a problem that may recur too often in the future. Several thoughts ran in his mind. With several initiatives to bring in large scale IT investments, he may face very similar issues. Will these issues become important with his dream "Cyber world" project that will entail huge outlay in E-enabling his business? He found enough reasoning in both their viewpoints. How should he reconcile these? Is there way to incorporate all these issues in the investment justification framework?

Exhibit 1
Proposal A
The traditional manufacturing system

In one method, the conventional special purpose machines, and a few NC machines could be used in a stand-alone fashion. This approach would require a total of 28 machines. The machines required include horizontal boring machines, milling machines, radial drilling machines, CNC lathes and grinding machines. The processing requirements dictate that the parts are refixtured five times before the entire processing is completed. This is either due to the change in the orientation of the component required or due to the special requirements of a particular machine. Inspection of the components will be carried out each time when the parts are refixtured. However a final inspection is also performed when the jobs complete processing. Using conveyors as the main material handling system it would be possible to organise the manufacture.

The estimated space requirements is about 1,80,000 sq. ft. The manufacturing cycle time will be about 16 days. Production capacity will be limited to 7000 per year. It is expected to run two shifts daily. At the shop floor level a total of 84 employees would be required for material handling, machine tending and maintenance. At the supervisory level 4 are required and at the managerial level 3 are required (one each for a shift and one overall in-charge who may come in the general shift). To cater to the NC machine, a programmer will also have to be recruited.

The system could be designed to handle a limited variation of a particular component. Of the 225 different varieties, less than 5% could be machined without significant production interruptions and another 20% could be machined with a changeover time of less than a shift. The rest of them may require detailed machine and tool setting. This would require a set-up time ranging anywhere between one and four shifts.

Exhibit 2

Proposal B
Flexible Manufacturing System

There is an alternative proposal for the manufacture of these components using a flexible manufacturing system (FMS). The FMS consists of nine machines:

- Five CNC machining centres (with a tool magazine of capacity of 60 each),
- Two CNC turning centres
- One head changer
- One co-ordinate measuring machine

The system will have a load/unload station with two parallel work stations, and a central buffer in the form of a carousel, which can hold up to a maximum of ten palletised jobs.

The material handling system consists of three AGVs. The AGVs can handle pallet loads measuring 40x48 inch up to 90 inch high with a total weight of 2,000 Kgs. Each AGV is equipped with a shuttle mechanism that allows it to transfer loads to and from the input output buffers. A 720 Ampere-hour 24 V Battery provides about 10 Hrs of continuous operation. Normal vehicle speed is 200 ft/min, with speeds limited to 165 ft/min in the wing interconnects. When the on-board computer detects that the battery is 80% discharged, the vehicles will complete its last task, notify the AGV control system of the low battery condition and be routed to the battery recharge area.

The AGVs are equipped with optical blocking controls that prevent contact between vehicles operating on a common guide path. In addition, each vehicle has an emergency bumper that will activate the brake system and bring the AGV to an emergency stop within the 21 inch collapsible distance of the bumper.

There will be a DEC/VAX mainframe computer and six workstations, which are networked to the mainframe computer. Together these will form the control system. All the software will have to be tailor made for the project. This would entail some cost and time overruns.

Parts released for production will be moved to the set up area where set up personnel will mount the parts onto the fixtures. The fixtures will be universal in design, consisting of a part holder, such as a vise and a pallet. An AGV will transport each palletised part between the stations. When the central computer determines that an appropriate machine is available, the AGV will be sent to the central buffer to pick up the pallet, move it to the available machine and unload it at the input station of the machine.

Exhibit 3

Some comparative details for the two proposals

The FMS currently will be initially designed to operate with a capacity to produce 6500 components annually, but it can be ultimately expanded by 60%. The space requirements of the FMS are one third of the conventional system. The manufacturing cycle time of FMS will be less than the conventional system by about 70%. Due to these, the WIP and finished goods inventory requirements are less compared to the conventional stand-alone system.

A typical operation will contain several transformation activities. For example, a part might be milled on two surfaces, have several holes drilled, and some tapped. The ability to perform multiple operations for a given part on the same machine is one of the greatest benefits from using the FMS. With the stand alone approach, each operation (rough milling, drilling, finish milling, boring etc.) would be done on ifferent machines, requiring transport time, scheduling and start up time for each processing stage. A preliminary study indicated that about 40% of machining time could be saved when the parts are processed on the FMS rather than on conventional machines.

FMSs typically employ general-purpose machines, which can be configured to the requirement by proper choice of tools in the tool magazine. This offers flexibility in machining different variations of a given component. The large number of tool magazines (60 each) allows the planner to deliberately build redundancy in tooling. This comes handy when the machines breakdown or tool breakages occur. The change over time from one family to another takes only 9 hours now. Quick downloading of part programs, and creation of new machine loading schedules are possible with the computer system. The AGVs provide the required flexibility in handling alternative routes and varying volumes. There is a wide range of benefits these systems can bring to the customers. Customer satisfaction will grow as a result of greater product reliability, speedier delivery, and quicker response to changing environments. Within the company the closer planning which the systems call for can improve efficiency, reduce wastage and cut out delays.

The software costs, training costs and the cost of the material handling system and the machining system are much higher for the FMS (see Table 1). The operating parameters for the two systems are given in Table 2. FMS requires less floor space, demands less investment in inventory and require less labour. The quality levels (measured as the percentage of the cost of the goods manufactured) are better with the FMS. However the initial investment in the system is very high compared to proposal A.

Table 1.
Investment details for the two proposals.

Description	**Traditional**	**FMS**
(a) **Machining System**	11.20	54.00
(b) **Material Handling System** Conveyors, AGVs, Transfer devices, feeders Parts orientation, pallets, fixtures	4.50	20.00
(c) **Control System** Computers, control system Software costs	 0.40 0.65	 10.00 12.50
(d) Spare parts for FMS		2.00
(e) Recruitment costs	0.35	0.20
(f) Training costs	0.10	1.00
(g) Site preparation	0.84	1.50
(h) Buildings, Floor Space	27.00	9.00
(i) Other preliminary expenses	0.50	1.00
Total expenses	**45.54**	**111.20**

Table 2.
Some operational details for the two proposals.

Description	Traditional	FMS
(a) Number of machines	28	9
(b) Floor space requirement (Sq. ft.)	180,000	60,000
(c) **Labour Requirements**		
Managerial (Salary Rs. 22,500 pm)	3	1
Programmers (Salary Rs. 17,500 pm)	1	3
Supervisory (Salary Rs. 14,000 pm)	4	2
Machine tending (Salary Rs. 10,000 pm)	64	
(Salary for FMS Rs. 12,000 pm)		18
Other direct labour (Salary Rs. 8,000 pm)	14	4
Indirect labour (Salary 5,500 pm)	6	2
Other overheads (Rs in millions)	3.9	2.5
(d) Direct material (Rs. Per unit)	3,200	3,200
(e) **Inventory Requirement**		
Raw material inventory (weeks)	10	6
WIP Inventory (weeks)	8	2
Finished goods (weeks)	6	2
(f) Cost of quality (% of Rs value) (Based on the cost of goods produced)	4	1
(g) Useful life (Years)*	8	10
(h) Number of working days per year	240	240

* The steering committee for capital equipments purchase has expressed its difficulty to correctly estimate the useful life of the FMS machines for the following reasons:

- The FMS machines are more robust.
- The FMS machines are more general purpose in nature and hence less prone to obsolescence.
- Unlike the stand-alone machines the same machine could be used for an altogether different application by simply changing the NC part programs.
- The figure of 10 years is only approximate, which seemed to be the best estimation in the opinion of the committee.