Introduction

Discussion around themes dealing with relationships between labour and management, has often been marred by emotive, almost pavlovian, responses; a consequence of historical experiences. If Australian Manufacturing Industry is to survive the present process of 'emasculation', 'knee-jerk' responses have to be replaced by well-reasoned consideration of the roles of all participants in its revitalisation.

2 DEVELOPMENT OF MANUFACTURING TECHNOLOGY

The introduction of robotics into industry must be seen as a part of a much broader process of development in techniques of manufacture. In the metal working industry, a major innovation adopted within the last decade or so, is the application of NC machinery. Wide support has also been gained for the reorganisation of the work process to incorporate the concept of 'Group Technology'. A concomitant innovation has been the adoption of computerized information processing systems to assist management. The next step, along the onward progress prescribed by the logic underpinning the development of manufacture, is the Flexible Manufacturing System.

Since small productions is the norm within manufacturing in Australia, methods sought to automate manufacturing, especially within small businesses, will need to reflect this characteristic. Thus the typical environment seeking advances in automation requires a high degree of flexibility of operation. Achievement of this flexibility is dependent on two significant factors.

Obviously the availability of suitable technology is one factor. Emphasis is placed on interlinking of machines in a way which can be readily altered, through simple hardware and software changes. Robots have played a prominent role in providing readily adaptable materials handling devices. They are often integrated into systems incorporating other flexible machines, such as NC machines tools and injection moulding machines. Therefore, automated systems, which have a fair degree of flexibility are built.

The next step on the trail leading to full and flexible automation is the Flexible Manufacturing System. This is based on the principle of machines becoming more closely integrated in control. They would then be able to form a sy which could provide optimal conditions for achieving flexibility of product mix and increase in activity.

The manufacturing environment that missed out productivity gains through automation of process is one that produces a multitude of products in small batches. This is the type of environment that has most to gain from FMS. Whether such system will become a feasible reality is a moot point.

To obtain optimal performance the production process has to be linked to a computerised management system which would supply details on part programming requirements, production estimate results, inventory control, pricing etc.

Because of the rapidity of change in product, in Australia will have to rely heavily on the on significant factor, a highly skilled and motivated workforce. The greater the variety, products, the greater are the demands on des maintenance, and trouble shooting of a system quite variable characteristics. There will for designing and setting up of programming requirements, production estimate results, inventory control, pricing etc.

This skilled labour-force would have to be a respond quickly. An efficient workforce be necessary for designing and setting up of optimal system configurations to suit the nature of new or modified products. This will require well co-ordinated activity between engineers, toolmakers, machine setters, operators. All participants must understand the desire response characteristics of the system so that correct system parameters are maintained. In response to production problems arising on shopfloor will have to be rapid, since there be insufficient buffers of work-in-progress accommodate anything but a short downtime sequence of any part of the system.

Along with a skilled workforce, flexible manufacturing requires appropriate information to
problems associated with information-flow have been
emphasized by the renowned writers on innovation, Rothwell and Zegveld (1979). They believe that
firms with 50 or more employees will have to
change their infrastructure to be able to accommod­
ate better organized information-flow. They see that
"In this type of industry the main problem
always has been obtaining the right material and
the right production information at the right time
with the appropriately skilled man and his appro­
priate tools and machines. In this context the
problem is solvable today: it is a matter of dev­
veloping the optimum information structure and the
software to computerize information flows . . . .
Now the multi-accessible database and an under­
standing of group-technology systems are available,
it can be expected that a radical change in these
industries will take place." (Rothwell)

3 LOGICAL PREMISE OF AUTOMATION

The historical development of machinery used in
manufacture has been based on a consistent under­
lying logical rationalisation process. Rationalisation in this context means a
reduction of activity associated with production
into a set of functions that can be scientifically objec­tified. As the Industrial Revolution pro­
gressed, the design of mechanisms moved from being created through the practical experience of inven­
tors, to designs based upon the laws of kinematics
and dynamics. The major prime mover of the
Industrial Revolution, the steam engine, preceded
its theoretical foundation, the Laws of Thermo­
dynamics. Once the design of engines was able to
move from a prescriptive list of practical exper­
iences, to scientifically rational rules, more
sophisticated steam plant was designed. This move
forwards a more rational approach to engineering
design was extended to the whole work process,
including human labour. Time and Motion study,
conceived by Frederick Taylor and Frank Gilbreth
in the late nineteenth century, was also premised
on rationalisation of work processes. Human work
was reduced to a set of movements which workers
had to perform as directed by management, within
the times dictated (Braverman). While the simpl­
istic techniques of the early writers are now
considered crude, still the basic concept behind
Scientific management is the organized study of
work, the analysis of work into its simplest
elements and the systematic improvement of the
worker's performance of each of these elements".
(Drucker P337). Management embraced rationalisa­tion,
among other reasons, as a means of exerting con­trol over a complex process, embodying a mul­
titude of social interactions. The desire was to
simplify the process so that it could be grasped
and controlled by management. Managers and
designers hoped that they would be able to resort
to scientific rationalisation of the human con­	ribution to the process of production. Such an
achievement would provide an objective means for
design, measurement and control of all facets of
production.

As a consequence of adopting means for rationalis­
ing all aspects of production, management hopes to
be able to make the organisation more responsive
to its demands; men in such terms as productivity
increases and swift reply to market forces. A
major problem with using rational objectification
of work is that it ignores the uniqueness of
human; it ignores both human will and the
desire for variety and control over one's activ­
ities.

4 CHARACTERISTICS OF AUTOMATION

As well as this rationalisation, manufacturing
industry has moved from being experience-based to
science-based. Complete knowledge required for
the process of creation by a person wielding a
tool guided by the experience of the craft, was at
first subdivided into a number of separate tasks at
the early period of manufacture, as has been des­
cribed by Adam Smith in the late eighteenth century.
With mechanisation, full knowledge of the process
was to be produced. The subdividing of tasks was
practised by management during the manufacturing
period when it was observed by David Noble,
the worker was not required to principles
involved in development of the mechanism. While
the chemical and electrical industries were reliant
on scientific knowledge from their beginnings, the
metal working industry has only recently started
the transition from experience-based to scientific­
based technologies (ASTEC sec 1.11).

The ASTEC inquiry on technological change and
employment found that the character of work changed
with the process of adoption of automation. The
role of the production worker in highly automated
processes shifted towards the control of the work;
monitoring and maintenance, which required a high level of
responsibility to intervene when something goes
wrong (ASTEC 1.11). There was also a trend towards
homogenisation of work as the repair and maintenance
functions of microelectronics are similar whatever
the industry.

Amongst the more highly skilled in the
industry, there is a tendency for trade­
smen in the traditional specialist areas,
such as fitters and turners, to be replaced
by tradesmen who are more versatile. In
production areas . . . observers have
noted a 'homogenisation' of the skills
required . . . with distinctions between
skilled, semi-skilled and unskilled tend­
ing to disappear. Many positions have
become relatively unskilled and 'quasi­
technical', perhaps requiring some tech­
nical knowledge but with a large component
of repetitive work; elements of judgment
and control by the worker over the pace
of work have been removed . . . .
(1.1.16) (ASTEC sec 7)

Accompanying this trend to increase the versatility
of employees with trade skills, is a desire to
reduce the skills of operators. A study of
computer-aided manufacturing, which had been
commissioned by CITCA, concluded from an inves­
tigation of 21 companies, that "Unlike many other
cost elements such as material and consumable tooling
and maintenance costs, labour cost is more obviously within
the control of the company to achieve significant
reductions" (CITCA). This desire to use unskilled
labour as operators of machinery incorporating
sophisticated controls was observed by David Noble,
a researcher employed by those most eminent
American institutions, M.I.T. and the Smithsonian
Institute. He is considered the foremost authority
on the history of both the American Machine Tool
Industry and the engineering profession. In his
study of NC machinery, he came to the conclusion
that NC manufacturers were able to sell their
products on the promises that all decision-making
could be removed from the complex, instrument-operating
assignment of unskilled labour for machine
attendance. Authority could be tightened by
concentrating all mental activity in the office.
Management thereby hoped to exercise detailed
control over all aspects of the production process
(Noble).
These trends which are most noticeable within industries reliant on dedicated processes, will probably become more common within other sectors of manufacturing as more highly automated techniques are adopted.

While trade skills tend to suffer from this 'homogenisation', as the character of manufacturing moves from being experience-based to science-based, the demand for employees with professional engineering and computer programming skills has increased.

Thus, a third trend which is visible across the manufacturing spectrum is polarisation of skill levels. For example, the programming of robots and computer-based tools may not be performed by those who operate them.

In regard to the quickening pace of work, accompanying the application of capital-intensive machinery, a study commissioned by the Myers' committee came to the conclusion that 'Due to the level of investment in computer-aided manufacturing equipment, efficient planning and control is vital to ensure maximum utilization. The introduction of computer-aided manufacturing therefore tends to lead companies towards restructuring their production management systems. In addition, the capacity of NC to concentrate more operations on one machine and reduce the throughput time of each batch requires tighter scheduling and control' (McPhersons). ASTEC reported that accompanying automation was a quickening of response to the diagnosis of a problem and corrective action. This aspect of automation is quite observable in the work associated with continuous casting of steel, where "... much time is spent watching dials without taking action, but precise and quick evaluation and action are expected if a malfunction occurs, in order to prevent disturbance of the workflow in an integrated plant with fine tolerances in timing." (ASTEC sec 7.14).

5 SHOPFLOOR SKILLS

In the case of NC machinery, the desire by management to use unskilled operators, and thus reduce labour costs, has only been partially realised. The Myers' findings showed that the majority of operators tended to be highly skilled; being 3rd or 4th-year fitter and turning apprentices or tradesmen. One would also "evidently... that those companies manufacturing in relatively large batch sizes tended to use lower-skilled operators, and relied entirely on the programmer to select and maintain correct operating conditions. Those companies are less inclined to require or even allow the operator to modify programs. Companies producing lower volume batches with short runs and frequent changeover from one product to another tended to employ more highly skilled operators and saw significant advantages in having the operator trained to modify programs whenever necessary at the work station". (CITCA). Zegveld and Rothwell (1979), of the Science Policy Research Unit at the University of Sussex, England, in their dissertation on Technical Change and Employment referred to a study of 24 firms using NC machine tools. It found that an NC operator generally only required 3 months training, as compared to 14 months training required by a conventional operator.

With Industrial Robots, skilled workers may be given some responsibility in regard to their programming, although, this is more often not the practice. Using historical precedent, there is even less likelihood of skilled workers programming robots when they become more integrated with the machines they attend, as is the practice with flexible Manufacturing Systems.

These descriptions, of the prevailing practice within industry, rest on a foundation of rationalisation. The path so formed leads to centralisation of decision making. Thus, mental and physical labour are separated; each becoming a province of different people. The complete knowledge of the process, involving both a theoretical comprehension and an ability to physically perform the necessary tasks, is therefore not possessed by a single person.

6 SKILLING RATHER THAN DESKILLING

A difficult task is now at hand; to counteract the current practice by proposing alternatives. ASTEC found that "... it is not uncommon for some large companies manufacturing in relatively large batch sizes... that those companies manufacturing in relatively large batch sizes tended to use lower-skilled operators, and relied entirely on the programmer to select and maintain correct operating conditions. Those companies are less inclined to require or even allow the operator to modify programs. Companies producing lower volume batches with short runs and frequent changeover from one product to another tended to employ more highly skilled operators and saw significant advantages in having the operator trained to modify programs whenever necessary at the work station". (CITCA). Zegveld and Rothwell (1979), of the Science Policy Research Unit at the University of Sussex, England, in their dissertation on Technical Change and Employment referred to a study of 24 firms using NC machine tools. It found that an NC operator generally only required 3 months training, as compared to 14 months training required by a conventional operator.

With Industrial Robots, skilled workers may be given some responsibility in regard to their programming, although, this is more often not the practice. Using historical precedent, there is even less likelihood of skilled workers programming robots when they become more integrated with the machines they attend, as is the practice with flexible Manufacturing Systems.

These descriptions, of the prevailing practice within industry, rest on a foundation of rationalisation. The path so formed leads to centralisation of decision making. Thus, mental and physical labour are separated; each becoming a province of different people. The complete knowledge of the process, involving both a theoretical comprehension and an ability to physically perform the necessary tasks, is therefore not possessed by a single person.

6 SKILLING RATHER THAN DESKILLING

A difficult task is now at hand; to counteract the current practice by proposing alternatives. ASTEC found that "... it is not uncommon for some large companies manufacturing in relatively large batch sizes... that those companies manufacturing in relatively large batch sizes tended to use lower-skilled operators, and relied entirely on the programmer to select and maintain correct operating conditions. Those companies are less inclined to require or even allow the operator to modify programs. Companies producing lower volume batches with short runs and frequent changeover from one product to another tended to employ more highly skilled operators and saw significant advantages in having the operator trained to modify programs whenever necessary at the work station". (CITCA). Zegveld and Rothwell (1979), of the Science Policy Research Unit at the University of Sussex, England, in their dissertation on Technical Change and Employment referred to a study of 24 firms using NC machine tools. It found that an NC operator generally only required 3 months training, as compared to 14 months training required by a conventional operator.

With Industrial Robots, skilled workers may be given some responsibility in regard to their programming, although, this is more often not the practice. Using historical precedent, there is even less likelihood of skilled workers programming robots when they become more integrated with the machines they attend, as is the practice with flexible Manufacturing Systems.

These descriptions, of the prevailing practice within industry, rest on a foundation of rationalisation. The path so formed leads to centralisation of decision making. Thus, mental and physical labour are separated; each becoming a province of different people. The complete knowledge of the process, involving both a theoretical comprehension and an ability to physically perform the necessary tasks, is therefore not possessed by a single person.
There are two possible routes for attaining a flexible workforce. Either, reduce the need for skill via a transfer of jobs to machines, or to raise the general skill level of the workforce. The second route has not been too popular, as an increase in the skill pool means an increase in the wage pool.

The practice of opting for a low skilled workforce is one of false economy. Again ASTEC has a contribution to offer. "If vigorous innovation is to be adopted in production processes, appropriate skilled workers are essential. They will also need to have a basic understanding of science and technology to enable them to create or adapt readily to new ideas and methods. In the absence of such skills and understanding, the innovation that occurs can be expected to use labour-displacing technology. To take maximum advantage of technological change it is essential to invest in human skills, not just equipment". (ASTEC sec 1.23).

ASTEC recommended that flexible opportunities should be provided for individuals to develop or upgrade their skills as circumstances change during their working lifetimes. It believed that the relative responsibilities and roles of employers, unions, and governments in the provision of training and retraining programmes required urgent attention (ASTEC sec 4).

8 ROLE OF UNIONS

Obviously unions must have a part to play in ensuring that adequate provisions are established for retraining workers. What other roles may the unions seek?

The ACTU Job Protection Test Case, which has suffered a long deliberation, concerns the insertion into the Metal Trades Award a number of clauses relating to job security. The section dealing with technological change, seeks a requirement for the employer to notify the union six months before any impending technological change. Consultation will be required in regard to such issues as redundancies, income maintenance, and retraining. This initiative, along with other legislative attempts and judicial interpretations, is quite narrow. Notification is restricted to the immediate effects on employees. Consultation is thereupon constrained to consideration of measures to avert or mitigate the adverse effects of such changes (ACTU, 1981).

The 1983 amendment to the Victorian Industrial Relations Act is an exception, as it empowers the Conciliation and Arbitration Board to make awards in relation to the duties and responsibilities of employers upon the introduction of, or decision to introduce, technological changes.

John Corina (1983), the Foundation professor of Industrial Relations, University of Sydney, believes that many unions may be impelled by the potentially traumatic and often unpredictable effects of the introduction of new technology to become more forward looking.

The Swedish Codetermination Law and the West German Works Council Act are much more stringent. Paragraph 91 of the German Act empowers Works Councils to intervene and demand correction of jobs that have been organized in a way that contradicts tested scientific knowledge with respect to human requirements (Jonasson). Instead of restricting discussion of technological change to a particular form which has been present, unions will most likely move to a position where they will desire to play a significant role in the choice of the technological form. A precedent has already been set in Australia. The ATEA, in its dispute with Telecom in 1978, put forward the concept of an Exchange Support Centre to counter Telecom's desire to set up Exchange Maintenance Centres.

The ACTU (1979), in its Policy on New Technology, demands that "trade unions, must, as a right, be included in the planning stage of technological change as a condition precedent to any changed operations." Furthermore the policy states that:

"Unions should seek to challenge traditional managerial attitudes and prerogatives regarding consultation, notice and the right of termination by, "

- Seeking through award prescription or by agreement obligations on employers to consult and negotiate from contemplative stages on the various issues arising from technological change
- The ACTU seeking the enactment of a Technological Change (Impact of Proposals) Act. This Act shall require statements of proposals from employers concerning technological change as it applies at the industry and at an industry and enterprise level."
- "The ACTU ...... shall seek complementary and supplementary legislation, which should provide that notice must be given to the relevant Labour Department and the Unions involved, of relevant information."

Note that the precedent for active involvement by unions in the selection of the form of work process associated with technological change came from a union whose members are highly skilled. Likewise, in Britain the most notable challenge to management's prerogative to choose the form of technology came from a highly educated section of the workforce; that is, the Alternative Corporate Plan put forward by Combined Shopstewards at Lucas Aerospace (Cooley).

Accompanying the change in composition of the union movement towards a more highly educated membership, the desire to participate in the design of the working environment, including its technological form, will become more prevalent.

9 ENGINEERING DESIGN: UNION PARTICIPATION

ASTEC referred to three possible approaches to such participation:

1. Consultative design where the bulk of design decisions are made by the traditional designers, while the objectives are influenced by the needs of the users.
2. Representative design, where the design group is comprised of representatives of users.
3. Consensus design, which involves all people affected by the design. A representative group may still be formed, but extensive consultation with all users is maintained.
Manufacturing industry should try to maintain and process of deskilling destroys the future potential desire to introduce new techniques that may have increased the skills of the workforce, because the change. There has also been some legislative and information and to consult employees, when they continue for much longer. The for some time a policy regarding technological on the maintenance of flexibility.

There are two alternative approaches to the automation of our industry. Techniques could be introduced which replace skilled artisans with less skilled operators, or else, techniques requiring skilled labour, working with highly advanced technology, could be implemented. The first technique has been a characteristic of adoption in large capital intensive industries with long production runs; for example, the petrochemical and steel industries. The second approach is the more suitable technique for an industrial setting dependent on the maintenance of flexibility.

While trade unions have not played a significant role in decisions associated with the introduction of new manufacturing techniques, this will probably not continue for much longer. The ACTU has had for some time a policy regarding technological change. There has also been some legislative and judicial moves requiring employers to provide information and to consult employees, when they desire to introduce new techniques that may have a significant impact on the process.

Manufacturing industry should try to maintain and increase the skills of the workforce, because the process of deskilling destroys the future potential for creativity. If the creative potential of our workforce is lost, any possibility of a reasonable degree of self-reliance and international competitiveness will also be lost.

The participation of unions in the decision-making process associated with the introduction of new techniques of manufacture should not be considered a hindrance. Instead, participation should be seen as a means of establishing an environment in which a spirit of co-operation will underlie the creation of a viable manufacturing industry based on a skilled and able workforce.

11 REFERENCES

ACTU (1979) Congress Policy Decision: Technological Change

ACTU (1981) Job Protection Test Case: Claim


COOLEY, M Architect or Bee?: The Human/Technology Relationship, Rand & Brain Publications, Slough, UK

CORINA, J (1983) Trade unions, new technology and incomes policy: disclosure and use of company information. Prometheus, Vol 1, No 2

DRUCKER, P F (1968) The Practice of Management, London, Pan

INDUSTRIAL RELATIONS (FURTHER AMENDMENT) ACT 1983 (Vic)

INDUSTRIAL RELATIONS ACT 1979 (Vic)

JONASSON, S (1979) Computerisation and Human and Social Requirements, IN A. MONSHOMITZ, Human Choice and Computers, 2, New York, North-Holland


AUSTRALIAN SCIENCE AND TECHNOLOGY COUNCIL (ASTEC) (1983) Technological Change and Employment: A Report to the Prime Minister, AGPS

COMMITTEE OF INQUIRY INTO TECHNOLOGICAL CHANGE IN AUSTRALIA, (CITCA) (1980) Technological Change in Australia, AGPS