Manufacturing *Breakthrough*

Editor
Rory L. Chase

Features Editor
Andrew Lee-Mortimer

European Correspondent
Anna Kochan

Sub-Editors
Michelle Argent
Domini James
Yvonne Norrish

Editorial Assistant
Deborah Kay

Artwork
Reg Freeman

Marketing Manager
David Watts

AIMS AND SCOPES

Manufacturing Breakthrough: Managing Product Development will provide executives and senior managers in industry with the information needed to create an effective product development process that will manage a viable concept into successful production in the shortest possible time.

Emphasis will be placed on organisational and management concepts, strategies and methods of implementation, which ensure competitive product development.

The majority of the magazine will provide case study features from companies in Japan, Europe and North America, and features/interviews from international authorities on the subject. The magazine will also include news and commentaries.

CONTRIBUTING EDITORS

Dr. M. Myrup Andreasen
Associate Professor, The Institute of Engineering Design, Technical University of Denmark

Professor Geoffrey Boothroyd
Department of Industrial and Manufacturing Engineering, University of Rhode Island (USA)

John C. Ford
Chief Engineer, Lucas Car Braking Systems (International)

Ian Milburn
Deputy Managing Director, Nissan European Technology Centre Ltd.

Keith Nichols
Manufacturing Consultancy Director, EDS Scicon

Professor Stuart Pugh
Babcock Professor of Engineering Design, Design Division, University of Strathclyde, Glasgow

Bob Reeve
Industrial Manager, The Smallpeice Trust

Philip J. Robson
Managing Director, NIS Ltd. (and an industrial member of the DTI's Innovation Unit)

Manufacturing Breakthrough: Managing Product Development (ISSN 0964-2366) is published bimonthly in January/February, March/April, May/June, July/August, September/October and November/December by MCB University Press Ltd., 60/62 Toller Lane, Bradford, West Yorkshire, England BD8 9BY (Tel: +44 274 499821, Fax: +44 274 547143).

All articles in this journal are protected by copyright, which covers the exclusive rights to reproduce and distribute the article (e.g., as offprints), as well as all translation rights. No material published in this journal may be reproduced photographically or stored on microfilm, in electronic databases, video disks, etc., without first obtaining permission from the publisher.

© Copyright 1993 MCB University Press Ltd.

Managing Product Development

Filtering out the good from the best

DAVID J. ROBERTSON, MARKETING MANAGER, TN TECHNOLOGIES, INC., AND **BRADFORD L. GOLDENSE,** PRESIDENT, GOLDENSE GROUP, INC.

TN Technologies, Inc., has never been short of new ideas for products, but after two acquisitions it found it had more ideas than it knew what to do with. In order to overcome this 'problem', the company enlisted help to organise the structure of its new product development process.

Although not always apparent from the documented evidence, concurrent engineering is as valid a management strategy for small/medium-sized companies, with the results from implementation as exciting and important to overall company success, as they are for the multinational giant. Similarly, the typical constraints and obstacles to achieving successful implementation – realising the need for change and taking the plunge, overcoming traditional attitudes, and so on – are no less a problem for the smaller companies.

Up until recently TN Technologies, Inc., formally known as Texas Nuclear, practised what can be described as 'a rather informal' system for deciding upon and developing new products – a process recognisable as still typical for most companies throughout Western industry. Less typically, the Round Rock, Texas, US-based company (now a Baker-Hughes company) has made significant changes to its product development practices over the past few years and subsequent projects are reaping the benefits.

TN Technologies, Inc. is a medium size company of about 250 employees that designs and manufactures level, density, flow and weight measuring instrumentation used in process industries, such as chemical, hydrocarbon processing, food and beverage, pulp and paper, etc. It also manufactures portable X-ray fluorescence analysers used in metal alloy identification, and flow and sampling equipment used in the waste water industry. The process control instrumentation products use a variety of technologies to make measurements – gamma transmission, neutron backscatter, ultrasonic time of flight, microwave radar time of flight – all of which have the common characteristic of being able to measure a process without making direct contact with the product.

Originally, the company's product development process would often be initiated with the 'marketing and sales' department providing an input to management of perceived needs for new products, along with an educated guess at potential financial results. Engineering would then respond with a list of questions about what specifications a new product should have, marketing would reply and the project was accepted or rejected. If accepted, engineering would begin the design based upon the marketing requirements, but often 'extras' would be added to a product throughout the development process. Once designed, the product would be passed to manufacturing for a pilot run. More often than not, problems would arise in the manufacturability of a product and so a flurry of change orders would be implemented. The final product would usually get component or sub-assembly testing, but would not always be tested as a complete instrument.

This development process had its inefficiencies but tended to work, within reason, due to the company's size and because much of the necessary communication between marketing, engineering and manufacturing did occur, even if it was informally at the coffee pot.

THE NEED FOR CHANGE

During the late 1980s the company made two acquisitions: Manning

Products, a manufacturer of level/flow instruments using ultrasonics, primary flow devices (flumes) and waste water samplers; and CannonBear, a company that designed and manufactured level instruments using microwave radar technology.

These acquisitions brought two new measurement technologies to the company: ultrasonic level and radar level. These new technologies complemented TN's traditional gamma transmission and neutron backscatter technologies and opened the door to many new products – in fact so many new opportunities that the company's informal process to select new products for development started to become overwhelmed.

Moreover, by the turn of the decade, it became clear to the company's top management that although the company was still trading very successfully, the overall development process inefficiencies meant that the company was too often doing a poor job of 'quality' – designs were not always manufacturable, products were slow to market, they were not always what the user wanted, and some suffered from an excess of technology – and this was no longer acceptable within the increasingly competitive climate.

INTRODUCTION TO CONCURRENT ENGINEERING

Recognising the need for a more formal process, new goals to improve new product development were set out by the company:

- Formalise project selection based on firm financial objectives.
- Design products to meet market needs.
- Improve time-to-market.
- Improve manufacturability (reduce change orders).
- Improve product qualification testing.

In order to achieve these targets, it was decided to implement concurrent product development (CPD), and to help in this process the services of a consultancy – Goldense Group, Inc. of Cambridge, MA, USA – were retained.

Although the president of the company fully embraced the concept of CPD, it was vital to plan its implementation and get full management support for the process changes. Therefore, for a few months senior management staff met once per week, after hours, to focus on integrating CPD into the company and to exorcise as many 'goblins' associated with this as possible.

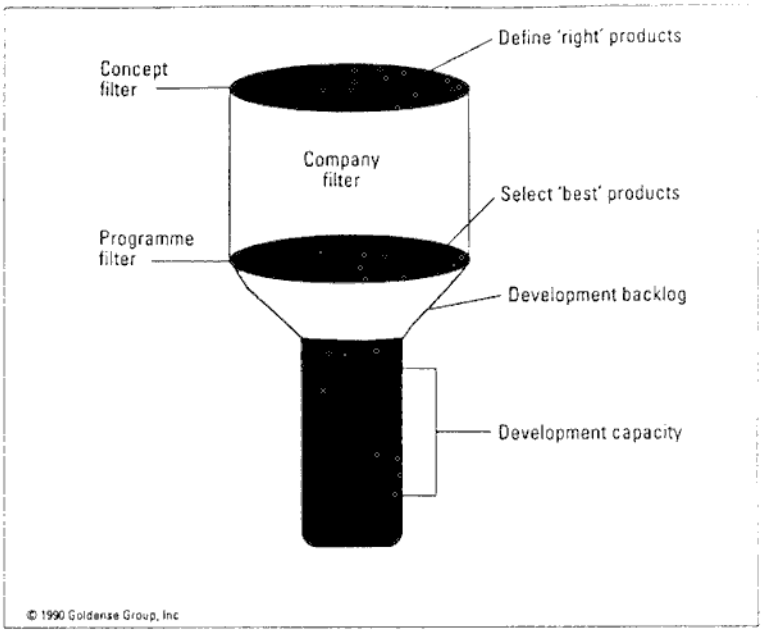

Fig. 1. Positioning for CPD: product filters.

The first stage in the implementation was the formalising of project prioritisation to help overcome the fact that there were more good ideas than the capacity to produce them. Following a series of interviews with managers, supervisors, salesmen, engineers and others at TN, a two-step 'filter' product selection process was formulated (Fig. 1).

The first step, concept approval, is to make sure that the right products are identified. Individuals put together a brief description of the product and ballpark financial information. The 'concept document' is then reviewed with the management for alignment to strategy. If approved, a development team is formed and assigned to the project. The second step, programme approval, is an in-depth analysis of the product with much more specific information and financial projections. Typically, there is some 'proof of feasibility' that occurs between the two steps to develop more specific information. The aim of this second step is to make sure that the best products are selected from among the right products that are given limited development capacity by achieving concept approval.

As regards actual product development, the company introduced a structured 'milestone-driven' process which utilises cross-functional development teams. The milestones, which had to be determined, refined and then approved, provide a simple framework for the development activities of the teams (Fig. 2).

To pilot concurrent product development (CPD), potential projects were formally defined and put through the first step in the new filter process – the concept filter. From a large list, three projects were given approval and teams were formed to further evaluate the project costs, time-to-market and potential sales. The time from initially retaining the consultant, through CPD process refinement and approval to team formation took about 5.5 months.

ERIC PROJECT

One of these pilot projects was to investigate the need for a new transducer. With the acquisition of Manning Products came ultrasonic level technology. A transducer Manning had developed was combined with a TN designed electronics transmitter package for sale to the waste water industry. The transducer, designed to measure liquid

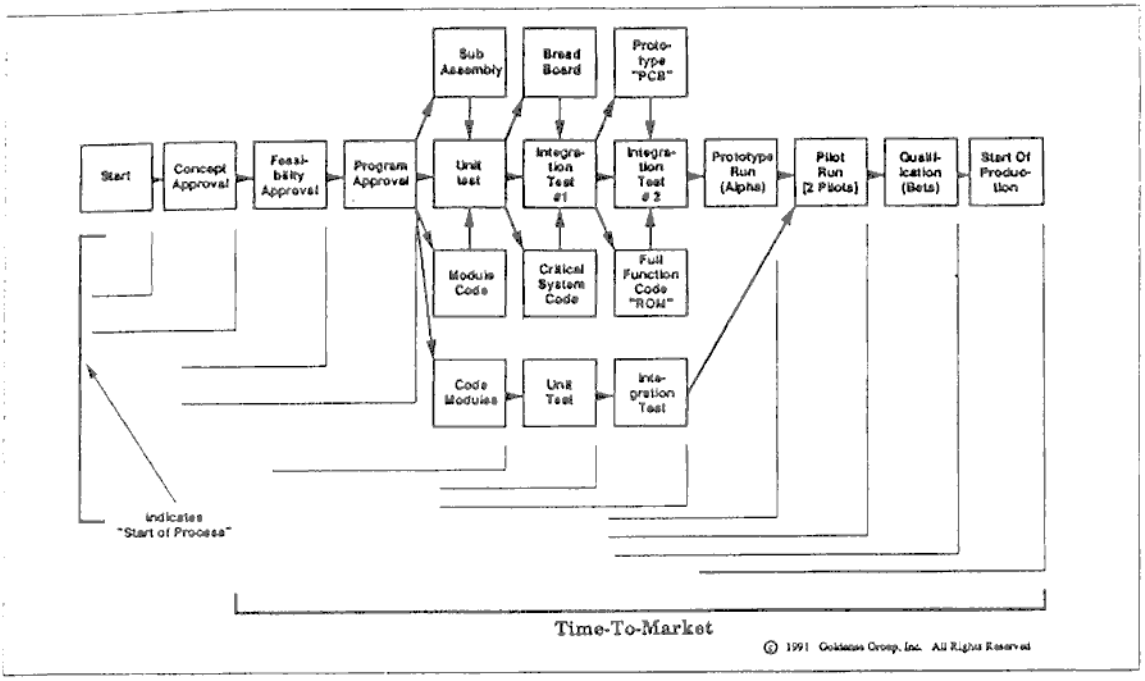

Fig. 2. Milestone chart – TN.

level, was housed in PCV with a silicon rubber face – materials well suited for open channel flow applications and level measurement of liquids that are not corrosive. However, in trying to sell the instrument to industrial customers, the field sales force found that the transducer needed to be able to withstand hostile process environments, such as corrosive chemicals, solvents, etc.

The core team for this project consisted of an individual from marketing, design engineering, and manufacturing engineering. The representative from marketing was appointed as team leader – a concept unique to the company's previously engineering dominated position. Once formed, one of the first acts of this team was to give the project the code name 'Eric' for ease of reference.

The initial project task was to formally plan the project, including:

- Market survey for sales potential.
- Establish product performance requirements.
- Set unit cost objectives.
- Estimate project cost.
- Develop a project time table.

Just as importantly, the team had to put considerable time and effort into learning about the CPD process – management requirements, project scheduling, etc. – and how to work and act as a team!

TEAMWORKING AND PROJECT MANAGEMENT

One of the first 'team' problems, which was encountered by all three teams, was that the members were asked to co-locate offices and this was met by some individual resistance. TN is a small company, all under one roof, so why move office? Moreover, all the members were on the teams as an additional responsibility, all had other duties which had to be accomplished.

There was the additional problem that the co-location issue was seen as 'turf-centred' by the middle and some senior management. Who would give up space and people, and who would gain?

Finally, after much debate, agreement and 'understanding' was reached and space was provided to create three physically co-located teams – members having offices next to each other and each team having its own conference room. In effect, with this act CPD was really born at TN.

Subsequently, it has been agreed by all concerned that co-location significantly enhances team communication and efficiency.

With the teams formed, the initial tasks were accomplished and formal plans presented to management for the 'programme filter' phase of the project selection process. All three projects passed this filter and were funded.

But, with this stage completed, another potential 'hiccup' in the CPD process itself came to the fore. The plan called on the teams to report to the senior management staff once every two weeks to review:

- Project time table.
- Project costs.
- Obstacles to successful completion.

There are always too many meetings to attend. The introduction of more meetings into the senior management staff's schedule was viewed with some level of disdain. Also the teams themselves initially looked upon these as a waste of time, and a rather daunting prospect – interacting frequently with the top management team.

However, they have proved their value and although there is still much talk about too many meetings, the management now look upon these as a positive event. With meetings lasting between 15 and 45 minutes, and the entire team typically

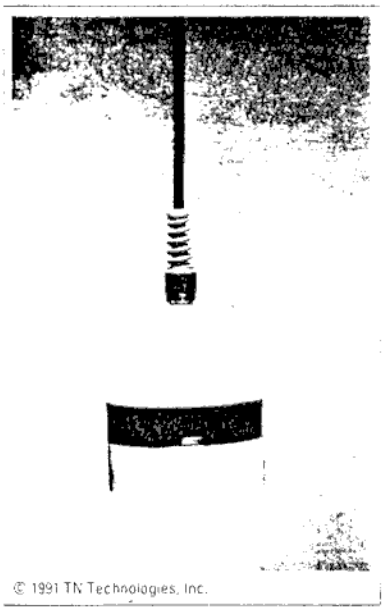

Fig. 3. The product produced by the Eric team.

attending, the management's purpose with this project review process is to find out about progress, and then to further empower the teams. The management looks to provide additional resources, remove bottlenecks, and otherwise speed the team along by making decisions on the spot.

The teams now appreciate the project review as well. Prior to the meeting, the teams hold their own project review and typically prepare a one-page schedule update and a one-page summary of accomplishments and resource requirements. It was found that this preparation kept members focused on the project, especially in light of other responsibilities to individual functional departments.

The only problem then was that initially the teams tended to wait for the reviews before bringing problems to management's attention. This had to be overcome by management maintaining frequent but less formal communication with the teams in-between meetings.

ERIC DEVELOPMENT

Some of the early 'Eric' project team efforts focused on a make/buy decision, but it was soon decided that no outside vendor could meet the performance criteria for the ultrasonic transducer and remain within target unit cost. After establishing the need to 'make', the next step was to determine materials of construction that were suitable to be placed in corrosive atmospheres. An alloyed steel was the early favourite, but engineering plastics seemed to have a wider range of chemical resistance. Also, it was felt that the sonic transmission properties of a plastic would be better suited to the end objective. After some research and acoustic testing, the team decided to use Teflon™ as the housing material. Once the material was decided upon, raw materials were ordered for prototype production.

It was at this stage in the project that the value of the bi-monthly review meeting was specifically illustrated. Obtaining machine shop time to build prototypes was very difficult, in light of production schedules. This fact was brought up at a review, and it was found that other teams were also falling behind schedule for want of machine shop time for prototyping. Acting on this, management decided to dedicate one machinist as a model maker, relieving any prototype delay.

Several prototype transducer designs were machined and the team was able to move ahead with testing for sonic transmission and other properties. Housing design was finalised, but one challenge remained – how to tag the transducer. The transducer was to be submitted to an approval agency for approval for use in an explosion safe area and the agency insisted that a tag be placed on the transducer. The characteristics that make Teflon™ ideal for chemical resistance make it very difficult to affix any sort of tag. Finally a solution was discovered. A narrow groove would be machined around the outside of the housing to allow for a thin metal tag. The tag is held in place by a piece of Teflon™ shrink wrap (Fig. 3).

A prototype run using the final 'released' design was performed partially as a prototype build and partially as training for the pilot run, and used actual manufacturing personnel. It also verified the solution for attaching the label.

There was then a pilot run and the final phase of the CPD process was to perform qualification testing on the transducers produced in the factory during this pilot run. The qualification testing was a CPD milestone requirement – a formal step that is critical to the CPD process and a much stricter market release discipline than had been the practice previously.

In fact, during the qualification tests a problem was found initially causing nearly 50% of the transducers to fail testing. Within a day, however, the problem was found to be in a default value – set for the old standard transducer – in the transmitter software

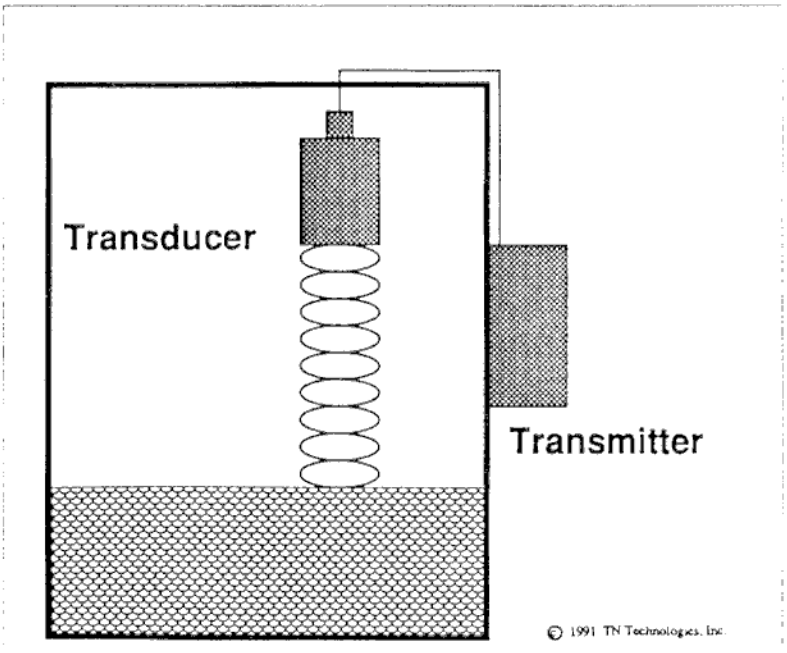

Fig. 4. Application of Eric.

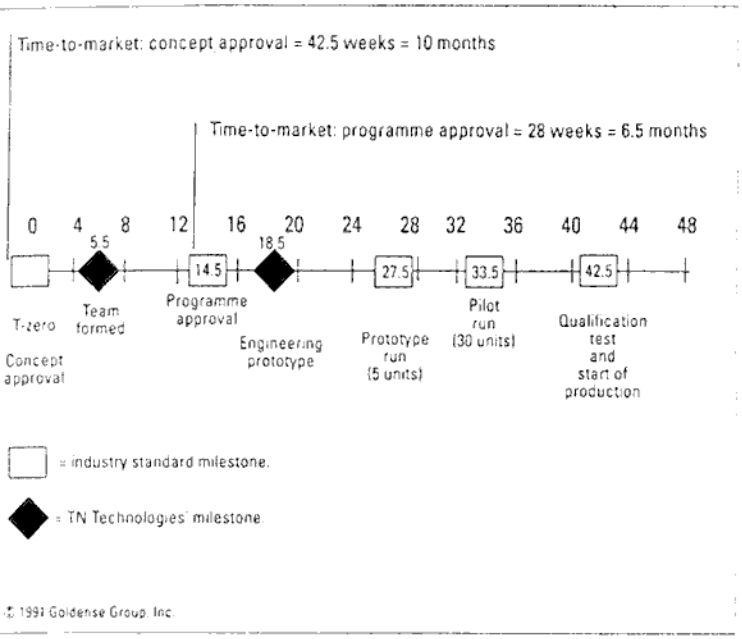

Fig. 5. Time line.

(the project being to develop a transducer which would operate with an existing transmitter to form the level measurement instrument, Fig. 4). A simple change in the instruction manual tells customers how to change the default value and input the correct value for the new transducer, listed on the transducer tag. Utilising this change caused *all* transducers to pass qualification testing.

Overall, this caused a delay in the release of the product by a few weeks. Had a formal programme to test transducers produced in the factory not been defined and in place as part of the milestone plan, the problem may not have been discovered until too late and, potentially, product could have been shipped which would not have functioned correctly when operated by the customer. A possible field problem was avoided and easily corrected by taking time to completely test the final product.

PROJECT RESULTS

Project 'Eric' – the company's first product to market using CPD – was achieved in a record time. Fourteen months after starting the CPD programme, 8.5 months after forming the team and only 6.5 months from programme approval, the product was in production (Fig. 5). This actual 'time-to-market' of 6.5 months was 40% less than some previous efforts. Similar projects in the past (prior to CPD) took 11 months. Furthermore, developmental cost was within 2% of goal, product unit cost within 4% of goal, and there have been no change orders to date.

COMPANY BENEFITS

As well as the success of the Eric project – improving time-to-market and general product 'quality', and proving the benefits of teamwork – there have been a number of other important accomplishments that will provide long-term benefits for TN as a result of the introduction of CPD.

The new process identified the need for an increased delineation and communication of company strategy to the product development functions. Senior management now produce a formal strategic plan, renewed annually, which is now used to drive new product development concept and programme approvals.

TN is a small company and the senior management team was always closely involved in product development. However, CPD formalised three of the major processes that involved senior management, and improved the structure of that involvement.

- Product concept: approve/reject/request more information/change scope.
- Programme authorisation: approve/reject/request more information/change scope.
- Project review: ongoing status of projects, meet every other week.

Also, the company is putting into practice much of what it learnt from its initial CPD experiences.

Similar to most small companies, the 'sales and marketing' function was primarily driven by sales. Marketing, and product management in particular, were not really focused on. The marketing manager primarily dealt with advertising, communications, and technical literature.

A new marketing organisation to concentrate on life cycle product management, which is separate from the sales organisation and managed as a separate entity, has just been established. Although the input from the sales people is vital, it is not always enough, as highlighted by one of the original pilot CPD projects that was delayed due to a lack of initial market analysis. Part way through it was found that the standard sensing technology being used in its product was in fact considered unreliable for the particular industry that the product was to be sold into.

The last of the three pilot projects also suffered some delay, compared to its target time-to-market, this time due to the use of part-time teams. Although the bi-monthly meetings helped to reduce the problem, the engineers on the team still suffered from a conflict of interest between teamwork and the need to sustain an on-going product.

However, the main point is that the company has done something about the problem. The initial use of part-time teams was due to a lack of resources and a too large appetite for new products. Since the initial CPD efforts, the company has organised two full-time teams for future projects. Also, the company is leaning towards giving the teams more autonomy and reporting, less formally but more frequently, directly to a top management individual who is fully empowered to help the team. Top management reviews would then be held every six weeks or so.

As for the future, there are always new areas to tackle if the change process is

not to grind to a halt, or start to reverse. As for TN, software improvements have not accelerated as fast as some of the changes in the mechanical side of the business, however changes are in process. Also, qualification and beta testing is similar to software in that it is not moving as fast as other process improvements. The company is currently in the process of developing robust qualification testing specifications and is looking at an increased amount of beta testing. Finally, although product manufacturability was generally improved by the teams, and in particular the 'Eric' team received significant and important coaching and advice from the model shop on this matter, there is still room for improvement. Future teams will have a better balance of manufacturing to design engineers, and now that teamworking is established tools, such as DFMA, can be employed.

Given the success of the 'Eric' project and subsequent projects, both company management and staff are convinced about the CPD/team-based approach. The members of the pilot teams are very positive about the experience and have become missionaries, spreading the philosophy.

In the final analysis, TN invested in CPD techniques because it had set itself a set of new product development goals that it had to meet in order to be competitive. Amongst other things, it felt that it had to improve product delivery time and should be able to get more new products to market than it had historically accomplished. This was achieved. TN was able to introduce more new products to the market in the past two years than it had done in the previous five. Some of this is due to a timing of payoff from R&D investments done during the five-year period, but much is undoubtedly attributable to the implementing of CPD. The company is also well on its way to meeting all the other goals as well.

ACKNOWLEDGEMENT

Additional input to the article by Andrew Makare, formerly director of engineering and now director of process gauges and municipal products, TN Technologies, Inc.

David J. Robertson is marketing manager, TN Technologies, Inc. He was previously regional sales manager for the company and prior to that he was with the USAF as a pilot.

Mr. Robertson has a BS Accounting from the University of Kansas, and a MA Management from Webster University. He is also a member of the Instrument Society of America (ISA).

Bradford L. Goldense, CMfg, CPIM, CDP is president of Goldense Group, Inc. (GGI). He has been assisting companies for the past 15 years in assessing, developing and implementing business and technology strategies. For the past four years, Mr. Goldense has concentrated his efforts on concurrent product development – CPD™.

Prior to establishing GGI, he worked for the Index Group as a consultant in business and technology strategy development; Price Waterhouse involved in specifying and implementing application software; Lester B. Knight and Associates specialising in product improvement and cost reduction manufacturing initiatives; and Texas Instruments as a project manager.

Mr. Goldense has a BS Engineering from Brown University, and a MBA from Cornell University, Johnson School of Management.

David Robertson may be contacted at TN Technologies, Inc., Round Rock, Texas, USA (Tel: (512) 388-9100, Fax: (512) 388-9200). Bradford L. Goldense may be contacted at Goldense Group, Inc., 6 Bigelow Street, Cambridge, MA 02139, USA (Tel: (617) 876-6776, Fax: (617) 876-6766).

An International Journal for Engineers, Managers and Reseachers with Responsibility for Automated Assembly Facilities

It charts international developments in both dedicated and programmable assembly, with special emphasis on the latest trends towards flexible manufacture.

Aimed primarily to meet the needs of engineers and managers who develop and apply assembly automation systems, *Assembly Automation* also looks in detail at the elements which comprise assembly cells, including parts identification and inspection, robot assembly stations, and system control.

Essential reading for engineers and managers working in a wide range of user industries, including mechanical, electrical and electronic engineering, food and pharmaceuticals and domestic appliance industries.

This quarterly journal includes features on the latest developments in assembly automation, reporting on up-to-the minute research findings. Alongside regular industry round-ups, and product information, *Assembly Automation* provides a comprehensive picture of happenings and developments in the automated manufacturing industry.

Assembly Automation
Vol. 13 Nos. 1-4, 1993

Subscribe Today!

Enquiries and Orders to:
Sue Bose, Customer Services Executive,
MCB University Press Limited, 62 Toller Lane,
Bradford, England BD8 9BY.
Telephone: (0274) 499821.
Telex: 51317 MCBUNI G. Fax: (0274) 547143.