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The 'green area' concept

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The 'green area' concept

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Abstract: The paper discusses the application of a new cell management system implemented in a UK company. The system was originally based upon the Nissan 'green area' (GA) concept but it was extended at the company into a complete business management structure covering the entire business. This new structure involved a GA system in the operational activities of the business, for example shop-floor and commercial activities, a 'business excellence' GA system primarily aimed at business improvement and development projects and a business strategic GA system. The GA system was used throughout the business and integrated the activities of cells in the commercial, engineering and shop-floor domains. It was more than the quality circle concept in that it also provided a mechanism for performance assessment, business control, improvement, training and communication.

Keywords: green area concept, cellular systems, team working, new organization structures

1 BACKGROUND TO THE 'GREEN AREA' SYSTEM

This paper is about the development and application of a new system for the management of group-based systems. The system, based on the Nissan 'green area' (GA) concept (1), was extended to a scheme for business performance assessment and control. In this paper application and development of the system are examined in a business in the East Midlands of the United Kingdom.

The company, Morris Mechanical Handling Limited, a crane and hoist manufacturer, is now organized into two main operating business divisions: standard products and engineered products. The standard products business makes hoists and small overhead cranes on a volume basis, mostly supplied from stock, but to a lesser extent assembled to order. The engineered products business is a contract engineer-to-order business making rail-mounted gantry cranes, rubber-tyred cranes, automation systems, ship-to-shore cranes and cranes for steelwork and other special applications. This paper primarily relates to changes in the engineered products business to improve performance.

Over the last three years the business has implemented a major restructuring of its activities with the aim of improving the overall time and cost control of product design and manufacture. One of the most significant changes was the introduction and establishment of cells throughout the business. In the factory the cells were designed using production flow analysis (2) to define the boundaries and products to be made in the cells and the design of the cell-based system

was much influenced by the work of Parnaby (3) and the concept of the 'natural group' (4). In the engineering design offices each cell was given responsibility for a family of similar contracts. In the offices the commercial cells were primarily designed to provide ownership of a particular information flow process, for example the sales ordering process. The overall design of the cellular system, described in earlier papers (5, 6), conformed to the five-system model defined by Stafford Beer (7) as an essential prerequisite for viability. Each cell had an internal supplier and customer to the cell team and thus was arranged in a flow path from customer specification to final product handover to the customer. There were, on average, ten people in each cell and these people were responsible for the production of a quality product and/or service to their customer cells.

To utilize the cell system to full effect there was a need to introduce a new cell management system that was simple to understand and would enhance and facilitate contract control. It was also intended that the cell management system would help to improve the morale and levels of involvement of the personnel. To meet these critical business needs the 'green area' (GA) system was introduced to the business.

The GA system is a disciplined management framework suitable for cell teams in any of the activity areas throughout the business. In the GA system, areas in the cell are set aside for every work group to meet their team leader during the first 15 minutes of each day. The area is arranged with table and chairs and becomes a focus for team meetings and other activities during the day.

In its original concept (at this stage unmodified by application experience at the company) the GA system had several features that made it particularly appropriate for

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the management of the cells, namely:

1. The high level of visibility of performance measures presented on simplified graphical displays facilitated control of the work programme in terms of time and costs.
2. The system increased the involvement of all the team personnel.
3. It improved communication, providing a forum for discussion about work and business related issues.
4. The system clearly assigned accountability, enabling the team performance and the individual performance to be determined.
5. A cross-measurement system ensured that the performance of the cell team was measured by the suppliers and customers of the cell.
6. The system provided a 'shop window' for the team, enabling them to clearly show their performance to people who visited the cell work area.
7. The system placed a responsibility on business managers to facilitate and encourage the development of a new working culture in the company and to respond promptly to relevant issues shown on the display boards.
8. The GA became a focus of contact for the team with people who were visiting the cell.
9. Planning and contract time and cost performance could be clearly shown on the display system.

2 THE OPERATION OF THE GREEN AREA SYSTEM

One of the most important aspects of the GA system was the morning or start-of-shift meeting. It was short (generally no longer than 15 minutes) and highly structured, covering some of the following issues:

- (a) discussion about the previous day's work output and achievements and remedial action if necessary;
- (b) brief discussion about the work for the current day or shift period;
- (c) the quality achieved by the team;
- (d) any absenteeism from the team;
- (e) the overall effectiveness of the team in terms of its ability to meet planned requirements;
- (f) the general level of housekeeping in the area;
- (g) any cost or time overruns;
- (h) any communication issues between employees;
- (i) training issues in the team.

The purpose of the team meeting was manifold: to ensure that everybody in the team knew what was happening in the team; that they were all involved in decision making; that they all knew how they, team or individual, were performing; and that they could clearly identify the work or training requirements for the day. Employee's personal problems were not discussed in this meeting and needed to be dealt with elsewhere.

At the end of the working day a team leader's meeting was held; this meeting reported on the day's progress and any problems raised. The team leader also received information from the business concerning overall business performance, issues about the operation of other teams and any general issues that could be taken to the next morning meeting of the GAs.

An important feature of the GA system was the display structure that was set up in each cell domain. This was a simplified graphical display board with a standardized format for the type and layout of the individual displays. In each GA there were the following displays:

1. An attendance register where people used a coloured dot system to identify their attendance at the morning meeting.
2. A skills register that indicated the skill of the individual team members, the skill requirements of the team and the training being carried out to close the gap. In the commercial design areas a professional skill rating was used as the measure to identify the professional competence of the individuals.
3. Measurements of the performance of the cells in terms of meeting the time and cost requirements of their workload.
4. GA members also identified improvements to the operation of the cells. Subsequently the members implemented the improvements and there were non-financial rewards for the best cells. If changes were outside the capability of GA members then a change co-ordinator would design and implement these ideas, working with the team in question.
5. There was also a cross-measurement system where other GAs that acted as suppliers or customers measured the performance of the cell. This system ensured that each GA could not suboptimize its own operations independent of its customers and suppliers, and it provided a much more impartial measurement of the operation of the cells.

One of the most significant graphical displays in the cell forming a key part of the GA system was the attendance register. This was a system for identifying an individual's presence at the 15 minute meeting that took place at the start of the working shift. It was important because it immediately showed who was present in the business, where they were and what they were doing. In the longer term it was expected that this method of recording attendance would eliminate the need for a clocking-on system for the factory floor.

The attendance register used a coloured dot system to indicate attendance. The codes used are defined below:

1. A green dot was used if the individual was present at the start of the morning meeting.
2. A yellow dot was used if the individual was late (for any reason) for the start of the morning meeting.

SKILLS MATRIX					
Specific Skills	Team Members				
	INDIVIDUAL PHOTOGRAPHS				
	1	2	3	4	5
FINITE ELEMENT ANALYSIS	□	○	□	○	○
DESIGN CALCS	○	□	○	○	□
STRUCTURAL ANALYSIS	■	□	□	○	□
GEARBOX DESIGN	□	■	○		○
CRANE SPECIFIC	□	▲	□	■	□
TECHNICAL WRITING	■	△	■	■	△
CAD	○	□	○	○	○
ESTIMATING	■	△	△	□	■
TENDER PREP	□	■	■	□	■
STRESS ANALYSIS	○	△	△	△	▲
TRAINING	○	□	○	△	
SYSTEM DEVELOPMENT	■	△		▲	○
MACHINE TOOLS	▲	○	○	△	
PRODUCTION TECH	□		○		
DESIGN ADMIN		□			
SITE ASSEMBLY			▲		
ELECTRICAL DESIGN	□				
COST ANALYSIS					
SITE ERECTION					

Fig. 1 A representative skill matrix for a design/engineering GA

3. A red dot was used if the individual was absent from the meeting for whatever reason. If the individual was absent for a work-related issue, the team leader would sign off the red dot as acceptable. A red dot signalled when a team member returned and if he or she needed briefing as to what the requirements, if any, would be.
4. A blue dot was used if the individual was on holiday or planned leave.
5. A gold dot was used if the individual achieved one month's period with no lateness or absence, no matter what the circumstances.
6. When six gold dots were awarded the individual was entitled to take one day off within the following month. Failure to do so would forfeit the day.

The same attendance system was used throughout the business in commercial, engineering and factory floor GAs.

The other important display was the skills register. In the manufacturing areas the register showed the machine tools that people were skilled to operate, the degree of multiskilling of each individual and their team leadership knowledge. The graphical displays also showed the training each person was receiving and this enabled the GA team to predict its future skill capability and whether it would be able to meet predicted work needs. In the contract design and engineering area the skills were professionally based and the assessment process was more complex. A typical form of the skill matrix used in the engineering and design area is shown in Fig. 1.

On the skills register a coloured dot system was used to identify the skill. The following codes were used:

1. A gold dot (this is shown as a square symbol in Fig. 1) was used if the individual was a member of an appropriate

institution and had a professional qualification relevant to or covering the subject. In addition the individual had to have at least five years relevant experience in applying the skill.

2. A black dot (this is shown as a filled square in Fig. 1) was used if the individual was qualified and had at least five years relevant experience, but was not at this stage a member of an appropriate institution.
3. A red dot (this is shown as a circle in Fig. 1) was used if the individual was qualified but did not have significant experience in the application of the skill.
4. A blue dot (this is shown as a triangle in Fig. 1) was used if the individual was in training to obtain qualifications and was gaining experience.
5. A green dot (this is shown as a filled triangle in Fig. 1) was used if the individual had an awareness of the skill but was not formally qualified.

Each level of competence in the skill assessment process was validated by a streamlined testing process devised by some of the professional engineers in the business and related to the Morris products. Specific professional skills, e.g. 'structural engineering', were then graded for each individual. At the start of each contract planning process the contract managers made an assessment of the skills for their contract and matched this to availability within the business pool. This enabled them to define their contract team structure and any training requirements to meet a particular contract need. Contract specific training was provided together with more general training to increase professional skill levels of the employees throughout the business.

To enable the GA system to work, many parts of the conventional organization structure needed to change. For example, the GA system did not fit well with the traditional supervisory 'command and control' management style, where work was distributed by a foreman-manager, who was also responsible for the discipline. This supervisory role had to change to one of enabling, training and facilitating. This needed significant amounts of new supervisory and management training and unfortunately not everybody could or would accept these new roles. People that could not adjust were moved to jobs that did not involve such high levels of interaction with personnel on a daily basis.

3 EARLY APPLICATION EXPERIENCE

In the early days of implementation a problem that showed itself with many of the shop-floor areas was just how little control many of the teams had in determining their work patterns and priorities. This was because their work programme was defined by functions outside the cell boundary. For example, production plans were formulated by a specialist production planning department and the work was then distributed by a supervisory management system. People in the cells could not exercise much control to the quantity or timing of the work flow.

In the engineering domain it was clear that the local measures of contract performance were being used, to good effect, by the cell members. The contract manager and the team membership were very much held to account for the performance of the contract and as a consequence the measures were very important. The engineering cell teams made much use of 'local-to-the-team' measures of time and cost of contract implementation with respect to the initial estimate that was specified at the time of tendering. The measures were also specified for individuals working in the teams—how they were performing in meeting their own personal work schedules drawn up jointly between them and the contract manager.

It became apparent, early on, that the cross-measurement system, where the cell team's performance was measured by other customer and supplier cells, was only being used, at best, sporadically. Even in the engineering/design domain where the local time and cost controls were extensively used, the cross measures were not being used to the extent that was initially hoped and planned for. The primary reason reported, from the surveyed responses, was that people did not want to upset others by formally identifying poor performance on the displays. If there were issues about service from, or to, supplier and customer GAs then team leaders preferred to go directly to the appropriate individuals and confront them directly. There was nothing wrong with this more direct confrontational stance for resolving issues between GAs, but there was still a need for the more formal cross-measurement system to be used. This was particularly true if the normal service from, and to, the GA was inefficient for reasons more to do with the technology of the system or system failures such as inappropriate schedules of production rather than people issues. The use of cross measures did improve to some extent, particularly when it could be clearly seen that the measure was not directly related to the person, but the use of cross measures was always rather limited. To counteract this apparent lack of improvement co-ordination between teams and to compensate for the reduced usage of cross measurement, while ensuring that an improvement and development structure was built in to the contract implementation process, a new cell system was introduced. These new cells were called the 'excellence' GAs in the business to identify their improvement and business development role.

After the GAs had been operating for one year, surveys were carried out to assess employee perception of the improvements made. The results of a typical survey, carried out in the design/engineering area, are shown in Table 1.

The surveys were conducted in every area of the business. They indicated that most people did think that improvements in control had been achieved and communication, particularly within the GAs, was better. However, there was room for improvement in other areas, particularly the cross-cell communications and the management feedback. To improve the situation and to enable the GA

Table 1 The response from the design engineering personnel to the attitude survey

	Strongly agree [5]	Agree [4]	Neutral [3]	Disagree [2]	Strongly disagree [1]
1. There has been significant improvement in contract control.	3	17	14	3	0
2. There has been improvement in team spirit.	0	15	16	6	0
3. There is improved communication inside the team.	6	22	9	0	0
4. The cells have improved communication between cells.	0	0	19	15	3
5. There is improved communication about the business in general.	1	9	17	8	2
6. Local team performance is now clearly shown.	0	21	14	2	0
7. The technical skills have improved.	0	2	20	11	4
8. The cells have improved the overall performance of the business.	0	10	25	2	0
9. There is now better feedback from management.	0	7	6	7	7
Number of responses					

system to work to fuller effect the following changes were made:

1. A new team briefing system was introduced and the brief was presented fortnightly with the purpose of informing GA team members about the overall business performance.
2. Managers sat in some of the GA shop-floor, design and commercial cell meetings and informally discussed concerns and issues with the membership.
3. The training system was improved by giving each GA a training and skill improvement budget administered by the team.
4. Training was provided to enable new roles for the supervisors on the shop-floor, from managing to facilitating.
5. Business awareness sessions took place, enabling GA members to share their knowledge with others.
6. Some membership rotation was carried out from GA to GA.
7. The team leaders were briefed to enable them to provide better and more timely information to the GAs.
8. The performance improvement system was reinforced by providing a system of non-financial rewards for well-implemented improvements.

4 ESTABLISHING THE EXCELLENCE TEAMS

A definition of the expectations of the 'excellence' GAs is given below:

- (a) to plan and implement improvement projects that were defined by the company strategic planning board;
- (b) enabling information dissemination among the operational GAs throughout the business;
- (c) ensuring that operational team GAs were actively involved in strategic improvement issues;
- (d) acting as a significant communication link between the operational GAs and the senior management.

Typical, across the business, improvements that would be considered the responsibility of the 'excellence' teams

were:

- (a) the manufacturing improvements to the cell planning and control systems;
- (b) in the engineering cells, the development of user interfaces for their stress analysis procedures.

The excellence teams met on a regular basis every two weeks and they drew membership from the 'operational' GA teams, as the nature and skill requirements of the improvement projects dictated. In addition, a facilitator was assigned to each excellence GA to lead and direct the implementation of the proposed improvements.

The facilitator was considered to be a key person in the business improvement process and great care was taken with his or her selection. Desirable skills and personality characteristics for these key people are defined below:

- (a) self-driving with strong association with the aims of the business;
- (b) a good communication style and the willingness to communicate and sell ideas and concepts;
- (c) the ability to not accept the prescribed wisdom but constructively challenge the established wisdom;
- (d) knowledge relevant to the design of a modern business.

These facilitators worked with and took their instruction from the excellence team membership. They were more concerned with the significant business issues and major projects that crossed boundaries between GAs and major projects that were strategically important to the business.

5 ESTABLISHING THE STRATEGIC GREEN AREA

To define long-term business direction the strategic GA was established. The role of the strategic GA was to determine the overall strategic orientation to the business and the prioritized actions which it should take to maximize performance in the short and longer terms. The membership of the strategic GA was composed of personnel drawn directly

from the ‘excellence’ GAs, senior business managers and marketing personnel. The linkage from the strategic team to other GA activities is shown in Fig. 2.

The strategic GA met every month to discuss and formulate long-range business planning issues. To help it do this it collected information from the operational GAs and improvement project proposals from the excellence GAs. It also obtained information from marketing about the customer trends and competitor actions and any new product developments of interest to the business.

The strategic GA was responsible for the implementation and continuing formulation of the business strategic plan. It learned from market changes and modified plans where there was a need, and within this framework it was possible to evaluate proposals from the excellence teams and derive a set of prioritized business development projects. These were then passed to the excellence teams for detailed planning, time and cost estimation and then implementation.

In the strategic cell there was a graphical display structure associated with the overall business performance and

customer trends. A format for the display system is shown in Fig. 3.

6 THE ORGANIZATION BASED ON THE GAs

The new organization structure based upon GAs and incorporating the ‘excellence’ and strategic GAs is shown in Fig. 4. The organization shown in Fig. 4 consisted of operational cells throughout the business. The excellence GAs were responsible for the co-ordination of improvements across the operational cells and the implementation of more complex improvements that were beyond the capability of individual cells. Strategic direction for the business, prioritizing of improvements and change were provided by the strategic GA cell.

7 THE RESULTS ACHIEVED

The older hierarchical style of management with multiple

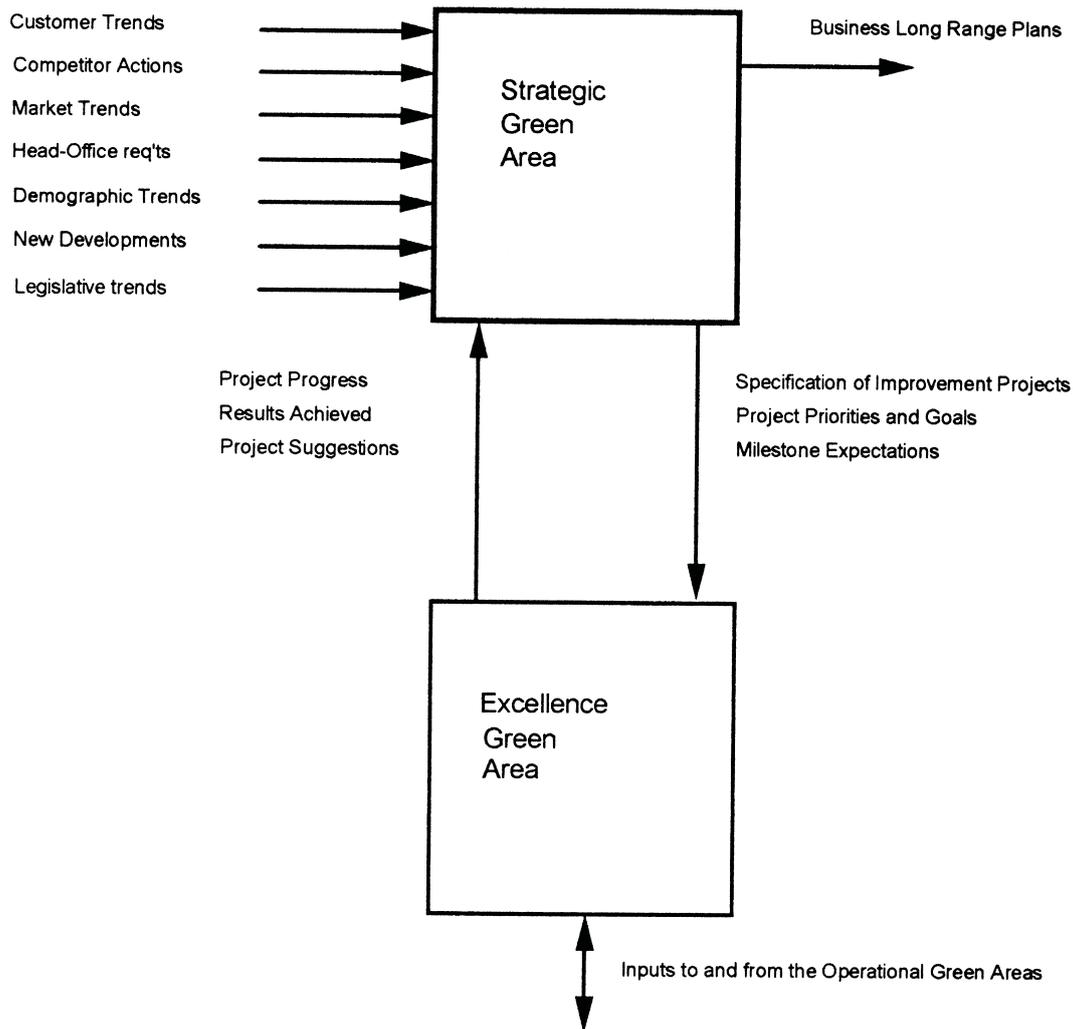


Fig. 2 The flow of information to the strategic team

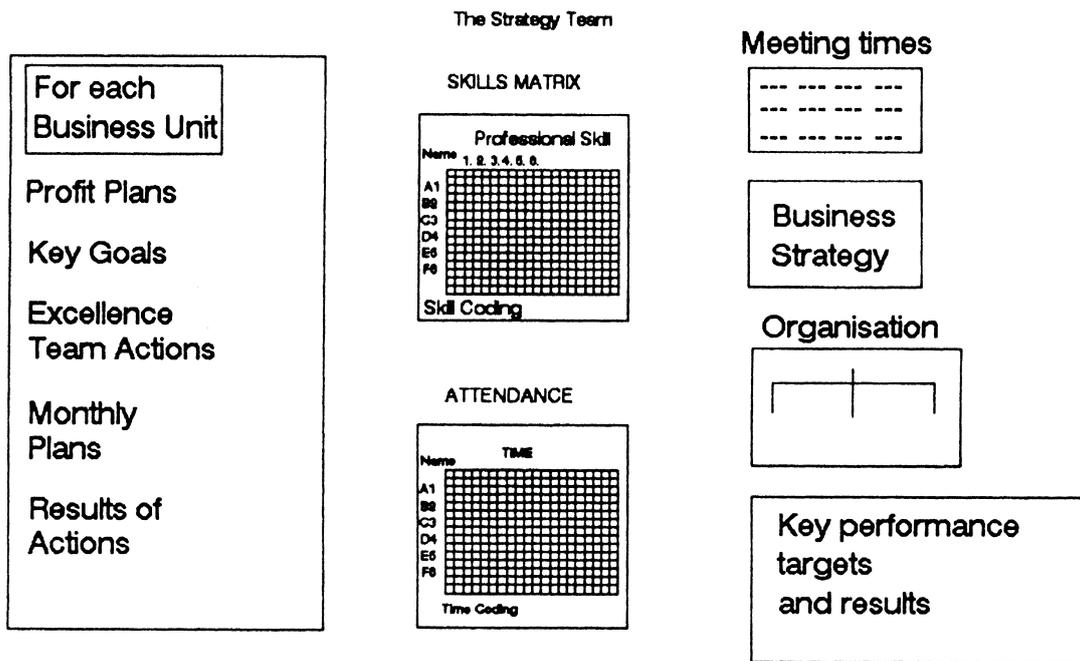


Fig. 3 The strategic team display structure

levels in the organization was no longer appropriate for this new cellular GA structure. The main aim of the changes in the business was to increase the level of personnel involvement in the business, improve time and cost control and ensure that the business introduced continuous improvement in response to market change.

The change to cell-based systems together with the new GA structure involving operational GAs, excellence GAs and the strategic GA all operating in a disciplined and highly measured system resulted in significant improvement to business performance. For example, for three recent

contracts taken at random after implementation, the performance detailed in Table 2 was obtained. After the changes the business started to make significant profits and this provided the momentum for further improvement and a reinforcement of the benefits of the new structure.

8 THE LESSONS LEARNT

The extended GA system implemented at the company was a new and simple system of management for cell-based

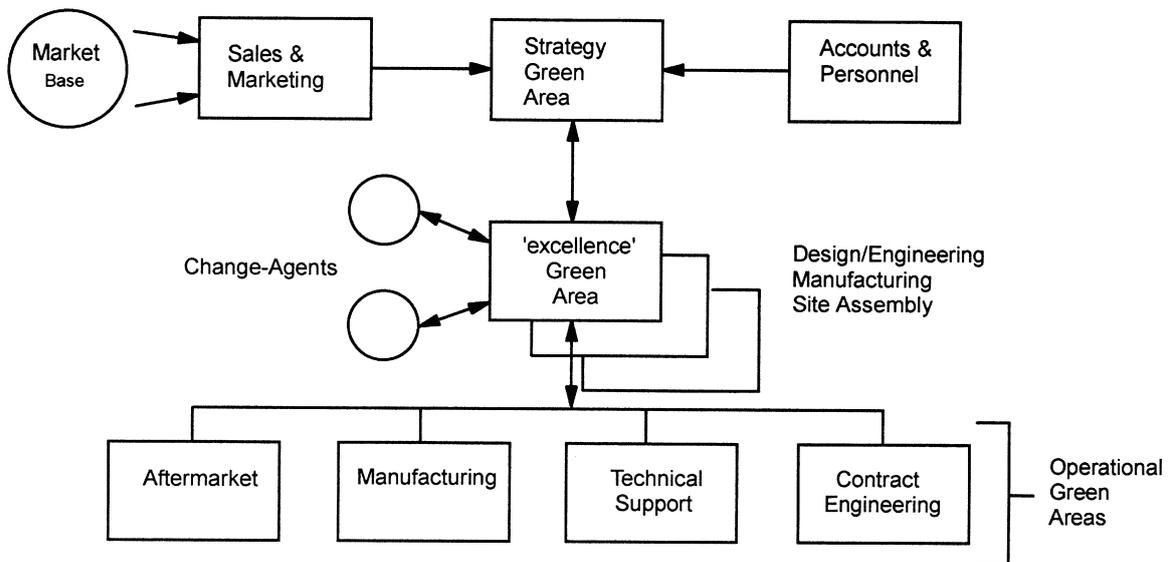


Fig. 4 The GA organization structure

Table 2 The improvement in performance contract time and cost control improvement

	Averaged previous contract (sample size: eight contracts)	Averaged new contract (sample size: five contracts)
1. Cost control of the contract	20% overrun each contract	10% overall reduction in estimated times
2. Labour costs	30% overrun	10% reduction in estimated labour costs
3. Purchased parts	10% overrun	20% price control reduction
4. Time for contract completion	10% overrun on an averaged contract length of one year	Within the average estimated contract length of nine months

business systems. The concepts had the fundamental principle of high levels of autonomy and the involvement of all employees. However, for the system to work effectively there had to be a series of complementary changes to the management style and culture to enable the people to fully participate.

The GA system does imply significant change to the organization structure. The business system must move from one where a supervisory managing layer distributes work to a largely passive labour force to an organization with a flatter, more facilitating style of leadership. If the 'requirement of everybody being involved' is unrealistic, then the involvement of a critical mass that will draw the others forward is certainly needed. Implied in such massive change is significant training, which is needed to ensure that everybody understands the new facilitating and supportive role. However, this new role is not the relinquishing of responsibility; each cell GA is responsible for its own domain of action. For example, operational GAs are responsible for effective business operation and their own team performance, the excellence GAs are responsible for business development and co-ordinated improvement and the strategic GA is responsible for ensuring the longer term business performance.

The company had to operate in a synchronized fashion and ensure that all the organizational aspects, such as leadership, culture and management style, reinforced a common message, e.g. shifting the payment structures from one based upon position in the hierarchy to one based upon skill and performance. As people acquired skills

they became more employable, more attractive to the contract teams and able to benefit more in the profitability of the business by receiving a bonus related to the profit generated on contracts and in the business as a whole. The theme of the organization had changed to skill, performance and improvement. The GAs enabled the change by providing a means for the control of the activities and the clear presentation of performance and progress.

REFERENCES

- 1 *The Nissan Green Area System*, a presentation by B. Middleton, South African Society for Quality, Eastern Cape Branch, 7 August 1990.
- 2 **Burbidge, J. L.** *Production Flow Analysis for Planning Group Technology*, Oxford Series on Advanced Manufacturing 8, Oxford Science Publications, 1989 (Clarendon Press, Oxford).
- 3 **Parnaby, J.** A systems approach to the implementation of JIT methodologies in Lucas Industries. *Int. J. Prod. Res.*, 1988, **26**(3), 483–492.
- 4 *Lucas MSE Handbook*. Lucas Engineering and Systems Limited, Dog Kennel Lane, Shirley, Solihull, West Midlands, B90 4JJ.
- 5 **Burns, N. D.** and **Backhouse, C. J.** Implementing cell based systems in a manufacturing company. In Fourth International Conference on *Human Aspects of Advanced Manufacturing and Hybrid Automation*, Manchester, 6–8 July 1994.
- 6 **Burns, N. D.** and **Backhouse, C. J.** Design of performance target systems or office and factory floor cells. In First European OMA Conference, Cambridge, 27–29 June 1994.
- 7 **Beer, S.** *Brain of the Firm*, 1972 (John Wiley, Chichester).