case 4

HQ Injection Moulding Company

'If we are to adhere to product launch schedules, we must try every mould on receipt, then bring in the mould maker to modify it as required, regardless of whether we can then go ahead and produce initial launch quantities', said George Brett, the manufacturing director. 'If we leave mould testing until we are ready for a production run there is a risk that the need for substantial mould modification will cause us to miss launch dates.'

HQ Injection Moulding had been a major components supplier to the domestic appliance industry prior to its acquisition by one of its customers. It also, at the time, had its own range of homeware products and supplied components to other industries. Some 10 years ago, the group was restructured and notice was given that the group requirements on the company would be phased out over the following two years. At that time, the parent company accounted for over 50 per cent of existing capacity (Exhibit 1 shows the make-up of machine sizes).

This was not the only problem. The company's homeware range also faced competition from small firms who were able to compete effectively in this sector of the market.

'The consumer saw our homeware products as plastic first and homeware second', said Graham Brown, the managing director. 'The traditional image of plastic as a cheap and transient material dominated, and we competed in the marketplace on price, rather than on the basis of our products. We had to rethink how we were to compete.' The company evolved a marketing strategy to design, manufacture and sell a range of high-quality products. This would enable it to compete in a different sector of the market where price was not the dominant order-winner. Over the years, the company designed several ranges of new products and the mould introductions associated with this are summarized as Exhibit 2.

Manufacturing

A brief outline of the process is shown as Exhibit 3. Starting with raw materials, a moulded product is produced. Certain subsequent operations (such as removing the

Exhibit 1 Details of injection moulding machines

Details of the number of machines available in each machine group defined by the company.

Machine group	Number of machines		
	Current year minus:		
	8	1	New
1	29	1	–
2	15	11	5
3	5	8	6
4	2	2	1
Total	51	22	12

Details of the 'new' machines in each group.

Machine group	Year of purchase/new machines							
	Current year minus:							
	7	6	5	4	3	2	1	Total
2	–	–	–	–	3	2	–	5
3	2	1	1	1	–	1	–	6
4	–	–	–	–	–	–	1	1

Details of a typical machine.

Machine group	Features of an average machine		
	Cost (£000s)[1]	Shot weight (ozs)	Locking pressure (tonnes)
1	116	10	200
2	276	45	450
3	333	60	600
4	360	150	600

Note
1. Cost includes the purchase price of the machine and installation costs at current year prices.

sprue – that is, excess plastic from the mould passageways – by hand, knife or drill, checking the quality of the moulding and first packing operations) are all completed at the machine. The products are then transported in containers to the work-in-progress stores. From there, they are withdrawn as required by the assembly department, who complete any subassembly operations (such as glueing or welding components), assemble (for example, fit lids to bases and attach labels) and finally pack into inner and outer cartons, prior to transportation to the finished-goods warehouse. With many of the products from the original product ranges the assembly and packing was completed during the moulding process, as the work content was relatively small due to the bulk style of packaging involved.

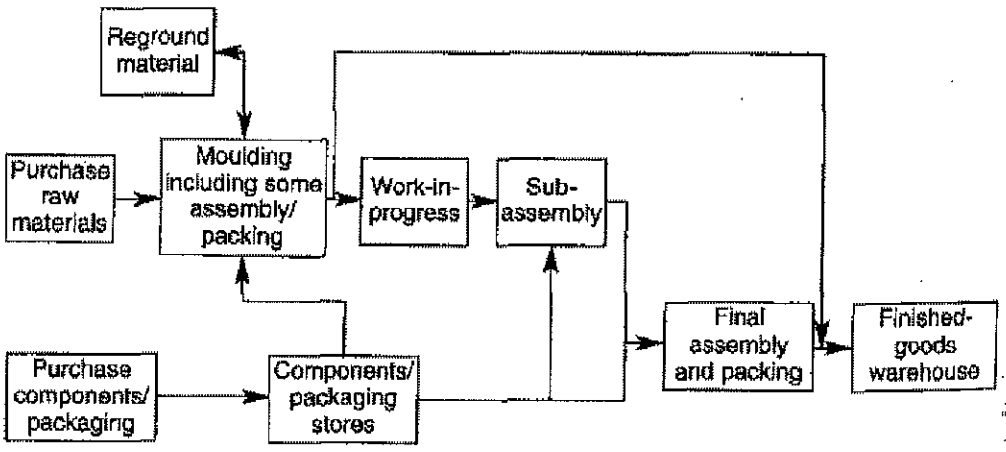
Exhibit 2 Summary of the moulds introduced or planned in the last seven years

Product range[2,3]	Number of moulds[1]							Current year
	Current year minus:							
	7	6	5	4	3	2	1	
A	–	–	1	5	–	–	–	–
B	–	4	1	1	4	4	2	–
C	19	8	10	8	3	1	–	–
D	4	20	–	6	1	2	12	–
E	4	19	–	26	9	14	15	30
F	–	–	–	–	–	2	–	–

Notes

1. The number of moulds indicates the number of different products within each range. However, in many instances, one mould will have two or more impressions on it, so that in every moulding cycle one, two or more products would be made depending on the number of impressions on that mould.
2. Product ranges A and B belong to the original (pre-change) designs, while C to F were of the revised (post-change) designs. Further details are given in Exhibit 5, under the column headed 'Product'.
3. The dimensional sizes of old and new products vary across the different product ranges but, in overall terms, tend to be similar.

Exhibit 3 An outline of the manufacturing and assembly process



Note

All products do not go through each stage of the manufacturing and assembly process.

Raw Materials

The advent of the new range of products brought with it a significant increase in raw material types and colours. In order to support the new product concept, more expensive materials were introduced and the colour range was widened. Also the old products had tended to be moulded where close colour matching was not required and material specification was less critical. Moreover, the new products were clustered around a 'matching' range of products as a strategy to enhance sales, with the purchaser who has bought one item for the home being more likely to buy another item of the set when next purchasing. This meant that it was necessary to maintain colour matches over a long period of time.

Toolroom

Nine skilled men (including three apprentices) work days, while one skilled man provides a breakdown service for the mould shop covering the period 22.00 to 07.00 hours. About 15–20 per cent of their time is spent on new moulds and the remainder on modification and repair.

Design

Over the years, design had expanded to become a separate function with a manager and four staff. Their job was to liaise with customers (often large department stores), agree on design detail then complete the drawings. The manager of the toolroom then undertook to make or subcontract the moulds and get them into production. The toolroom always had one draughtsperson, who dealt with mould modifications.

Technical Services

The technical support to the mould shop is provided by John Burton, the technical manager. John has extensive knowledge of injection moulding and provides specialist help on the shopfloor. The work varies and includes:

1. Contributing to the design of a mould at the start of the mould-making process
2. Getting new moulds to a production state and establishing the settings and adjustments to be made in all future runs
3. Fine tuning a mould at the start of its production run (very important in terms of productivity)
4. Helping to determine the necessary modifications to a mould.

Before the switch in product concept, John would spend most of his day on task 3, but increasingly, due to the new product strategy, John and his staff of three technicians spend the majority of their time on the other three tasks.

Until six or seven years ago, we concentrated on thinning product wall thickness and reducing cycle times because, particularly with the long production runs associated with the old-type products, this kept the cost down. The mould was made as cheaply as possible and we used black plastic where we could so that we could use reground plastic of mixed colours. And, of course, we would use contrasting colours for lids and bases, to avoid the need to colour match.

The new products changed this. We increased wall thickness to give products greater rigidity and substance, colour match became critical, lids and bases were the same colour, quality took precedence over cycle times, packaging became far more important and quality became the order of the day. The repercussions of this on the shopfloor were considerable. A new team had to be trained and premoulding treatment of material became necessary to achieve the necessary colour and quality standards.

Many existing machines were old and often unable to meet or maintain the new product specifications. Until new machines could be justified, sanctioned and installed, many preliminary operations were necessary to overcome the inadequacies of the old machines. As an estimate, only some 25 per cent of the machines were originally up to meeting the new technical specifications required, due to wear and tear.

On the technical side, our existing fitters had to be retrained to set up moulds with complicated water circuits, heating subsystems, temperature controls and complex core-pull and ejection systems. A new class of staff, the technician, became necessary. Recruitment from outside proved fruitless, and our best setters took on this role, with the best operators replacing them as setters.

The proposed range of moulds appears bigger and more sophisticated. Overall, machine setting is now more difficult and the machine adjustment controls are inadequate for the fine level of tuning required. When several new product ranges are introduced within a short period, everyone is under pressure. The new machines due this year will have microprocessor controls with the set-up reductions it brings, justifying the 15 per cent increase in capital cost. Although we expect this margin to decrease over the next year or two, persuading top management that this additional expenditure is necessary as standard policy is a different matter. These three new machines will be groups 2, 3 and 4, with locking pressures of 450, 600 and 600 respectively.

Maintenance

According to Phil Stokes, the maintenance manager:

many of the old machines weren't up to the quality specifications required by the change of product mix. For this reason, new machines were bought and the worst of the old machines sold. Now, besides the high-volume, low-margin products, we also make low-

volume products. Our revenue and profits have both increased. For my department, this has meant fewer machines and fewer problems.

Exhibit 4 gives the financial information for the company for the last seven years.

Exhibit 4 Some financial management information for the last seven years (year ended 31 December, all figures in £000s)

	Current year minus:						
	7	6	5	4	3	2	1
Fixed assets							
Plant	561	552	399	420	612	838	980
Moulds	102	130	170	180	320	584	620
Total	663	682	569	600	932	1422	1600
Current assets							
Inventory	262	532	1029	1259	1559	2243	2567
Debtors	483	798	842	817	1321	963	1373
Total	745	1330	1871	2076	2880	3206	3940
Current liabilities							
Creditors	626	532	628	1134	1774	1744	1765
Overdraft	2	480	412	42	38	284	575
Total	628	1012	1040	1176	1812	2028	2340
Working capital[1]	117	318	831	900	1068	1178	1600
Net assets employed[2]	780	1000	1400	1500	2000	2600	3200
Financed by							
Share capital	50	50	50	50	50	50	50
Retained profit[3]	280	420	530	570	830	1760	2660
Total	330	470	580	620	880	1810	2710
Group indebtedness	450	530	820	880	1120	790	490
Net capital employed	780	1000	1400	1500	2000	2600	3200
Net sales	2552	2872	4212	4466	5810	5394	8021
Net profit before tax[3]	146	185	274	362	564	708	1050

Notes

1. Working capital = current assets − current liabilities.
2. Net assets employed = fixed assets + working capital.
3. Any difference between the net profit for any year and the increase of retained profits is due to a transfer of profit to the group.

Mould Shop

'We are now in a totally different manufacturing situation than we were previously', was George Brett's opening comment when discussing the present situation. At the beginning of the change-over, he explained, there were several technical difficulties that had not been foreseen. These ranged from the inadequacies of many old machines to do the job, through to the moulding properties of the new materials.

He recalled how jobs had often to be allocated to a larger machine in order to achieve the required product specification (for instance, an increased locking pressure was needed to keep a mould closed during the machine cycle to avoid 'flashing'). Also, there were great difficulties experienced with colour matching, especially in the 'bright, modern' colours now being used.

> We even had to rethink our mould design, in some cases, from one that minimized the cycle time by injecting in the centre of the mould (that is, the shortest distance for the material to flow) to injecting so as to minimize the sprue mark, which lengthens the time cycle[1] and complicates the moulding process. Since then, we have overcome these initial difficulties and many more besides. But, in doing so, it has resulted in a lot of pressure, effort and cost. At times we can have seven or eight of the machines working on new products, which effectively means no production, and a complete loss of productive standard hours from some 30 per cent of our capacity. The problems of trying to complete the tasks of a development unit and a production unit under the same roof, and calling on the same capacities and skills, are enormous. The pressure of achieving deadlines, particularly when little or no slack time has been allowed in the plan (the design/customer agreement phase always absorbs whatever slack there is), requires all our attention so that normal production has to look after itself.

As shown in Exhibit 1, the available production capacity had shifted towards larger machines, sometimes in actual numbers, but markedly as a percentage of the total capacity available. To keep moulding costs down moved the argument towards multi-impression moulds, whereby every cycle produced a 'shot' with each of the impressions in the formed state (for example, two lids or two bodies, or two lids and two bodies, and so on). Of course, multi-impression moulds always become much larger and much more sophisticated. These, in turn, require larger machines and accounted, in part, for the drift away from the earlier mix of machines. In addition, mould changes and set-ups take longer and details of a representative sample of products throughout the current range is given as Exhibit 5. Besides the cost advantages inherent in multipurpose moulding, particularly with high-volume production runs, another advantage gained is that it facilitates the moulding of a product that has more than one component and where colour matching is essential.

Part of the production management's job was to consider ways of reducing costs throughout the process wherever possible. Some of these suggestions come from marketing pressure in addition to the continuous flow of ideas from manufacturing itself, with the aid of support services such as industrial engineering, toolroom and

design. Exhibit 6 gives cost breakdowns for some representative products from across the current ranges.

Assembly

The assembly department undertakes subassembly, final assembly and packing, and is located away from the mould shop in a 50,000-square-foot warehouse, which also contains work-in-progress and some of the finished-goods inventory. The work of this department has increased with the need for packing and presentation that accompanied the new products. At the other extreme, any assembly or packing of the industrial products is mainly carried out at the machine. There are, at present, some 17 assembly benches and three subassembly locations, with 27 full-time and 16 part-time packers and an indirect staff of three.

Finished-goods Warehouse

Although the product quantities have decreased since the early 1970s, the requirement for warehousing is considerably higher. Reasons for this include:

1. subcontract industrial work for the group was moulded on a contract basis and shipped daily to the various companies
2. the traditional homewares and industrial products were (and still are) packed several together, inside a box or polyethylene bag
3. components required to assemble the new ranges of products are greater
4. the emphasis on quality means that components have to be stacked with greater care
5. the new products are packed individually in inner boxes, increasing the space requirement at the finished-goods stage.

Work-in-progress and finished-goods warehousing capacity has been increased significantly, as shown in Exhibit 7.

Production Control

'The new range of products presents a set of production control problems, that are different from those of the old products', said Geoff Sissons, the production controller. 'The number of components and the assembly and packing requirements have increased the complexity of the process.' Exhibit 5 illustrates this.

In addition, the uncertainty inherent in the mould-testing process, the procedure for agreeing packaging and the launch dates have added factors which made planning and control far more difficult.

Exhibit 5 Production, sales and inventory details on several products[1][5]

Product[1]	Machine group	Number of impressions[2]	Number of colours	Number of components[3]	When last moulded: Months ago	When last moulded: Colour changes	Production run (hours): Last[4]	Production run (hours): Average[5]	Production runs last 12 months	Hours to change[6]: Mould	Hours to change[6]: Colour	Annual sales (units)	Finished goods[7]: Units	Finished goods[7]: Colours	Outstanding orders: Units	Outstanding orders: Colours
(A) General Homewares: Original Product Concept																
1132 Tray	2	2	1	3	27	1	1700	1700	–	2(½)	–	20 686	67 159	1	–	–
2225 Bowl[8]	2	1	8	2	1	3	192	248	6	2(1)	2	159 120	33 769	8	–	–
1138 Bucket	3	1	8	2	6	3	138	138	1	3(1½)	2	13 236	5 829	5	–	–
1386 Jug	2	1	1	3	2	1	190	147	3	3(1)	–	44 237	34 618	1	–	–
1283 Tray[8]	2	1	8	5	5	4	70	120	4	2½(1)	1½	48 162	15 050	8	–	–
2687 Tidy	3	1	2	4	1	2	124	82	7	7(3)	2	50 400	8 260	2	–	–
2241 Bin	3	2	6	7	1	5	103	100	4	13(5)	2	47 646	3 642	5	195	1
2386 Bin	3	1	1	2	–	1	156	120	6	7(1)	1	11 778	–	–	288	1
1393 Box	2	2	2	2	1	1	190	83	6	2½(1)	1½	22 405	3 967	2	–	–
1267 Tub	3	1	1	1	5	1	44	44	1	2½(1½)	1½	13 465	784	1	–	–
8282 Bowl[8]	3	4	6	3	2	6	220	259	2	10(4)	2	57 840	480	6	–	–
(B) Industrial Mouldings: Original Product Concept																
6900 Board	2	1	2	1	8	2	144	144	1	1(–)	½	6 735	–	–	–	–
6906 Basin	4	2	1	2	2	1	62	62	1	22(10)	–	–	–	–	–	–
6074 Lid	2	1	1	2	3	1	45	45	1	3(1)	–	–	–	–	–	–
6010 Tray	4	2	1	–	50	1	106	106	–	3(1)	–	–	–	–	–	–
6085 Knob	1	2	5	1	16	2	125	125	–	2(½)	½	–	–	–	–	–
6990 Frame	3	1	1	4	2	1	163	163	1	24(10)	–	–	–	–	–	–
6491 Cap	1	6	1	1	6	1	110	511	6	2½(1)	–	533 318	–	–	48 703	1
6209 Case	2	1	1	5	4	1	95	83	7	7(3)	–	86 159	1 152	1	–	–
8860 Tray[10]	4	1	12	1	–	1	2400	371	10	9(3)	½	159 489	4 804	6	19 835	1
8009 Case	3	2	2	1	8	2	60	54	1	11(5)	½	5 443	3 650	2	–	–
8010 Tray	3	1	2	1	4	1	90	36	2	11(5)	½	2 741	717	1	–	–
(C) General Homewares: Revised Product Concept																
3910 Container	3	1	10	5	1	3	134	87	8	4(2)	3	35 238	520	2	7 917	3
3941 Rollholder	2	1	3	8	10	3	55	55	1	13(3)	3	3 312	610	2	432	1
3995 Container	3	1	10	5	30	4	77	77	–	3½(2)	1½	157	108	2	–	–
6115 No. 4	3	4	6	5	14	5	20	20	–	9(1)	6	13 614	28 225	6	–	–
6110 No. 9	2	1	9	4	20	1	24	24	–	3(1)	2	1 242	6 660	8	–	–
8246 No. 28	4	2	12	4	1	5	61	39	9	7(3)	4	14 472	6 485	12	–	–
6151 Jug	2	1	4	3	20	3	102	102	–	9(2)	2	3 284	1 035	2	209	2
6313 Box	1	1	4	6	30	1	24	24	–	3½(2)	2	405	6 294	3	–	–
6332 Rack	4	1	6	3	3	3	106	106	1	10(4)	3	18 453	2 489	5	–	–
6846 Shelf	4	2	2	9	4	2	42	92	2	8(4)	2	19 598	2 003	2	–	–
6463 Clock	3	1	4	10	14	3	78	78	–	2½(1)	1½	6 393	1 749	4	–	–

Product[1]	Machine group	Number of impressions[2]	Number of colours	Number of components[3]	When last moulded: Months ago	When last moulded: Colour changes	Production run (hours): Last[4]	Production run (hours): Average[5]	Production runs last 12 months	Hours to change[6]: Mould	Hours to change[6]: Colour	Annual sales (units)	Finished goods[7]: Units	Finished goods[7]: Colours	Outstanding orders: Units	Outstanding orders: Colours
D) Bathroom Ranges: Revised Product Concept																
5426 Holder	3	2	10	7	–	2	67	155	14	4(2)	2	119 357	–	–	12 816	8
5229 Dish	4	2	9	6	–	2	45	110	7	4(2)	2	40 819	965	4	4195	4
5524 Holder[11]	2	1	10	8	–	3	40	40	1	14(2)	2	–	3 240	3	3 240	3
5315 Dish[11]	2	1	5	7	–	3	20	20	1	14(2)	2	–	1 080	3	1 050	3
6213 Hook	2	2	10	6	17	2	47	47	–	4(2)	1½	2 018	12 725	8	–	–
6420 Mirror	4	2	11	9	1	1	39	39	5	5(2)	1½	11 768	15 263	7	–	–
6428 Holder	1	2	13	5	1	2	35	35	5	2½(1)	1	16 913	21 392	10	–	–
6606 Beaker	3	4	5	6	1	2	33	50	3	5(2)	1½	24 244	18 785	4	3 000	1
6397 Caddy	3	1	4	8	1	2	95	34	3	8(4)	1½	10 752	11 167	4	–	–
6309 Mirror	4	1	4	8	1	3	43	32	4	4(2)	1½	9 720	3 994	3	1 500	1
(E) Kitchen Ranges: Revised Product Concept																
4141 Bowl	4	2	4	4	2	2	80	80	8	3(1)	1½	58 850	12 280	4	–	–
8284 Large sieve[12]	3	2	4	7	1	3	100	35	8	3(1)	1½	39 638	86	1	8 222	3
4150 Small sieve[12]	2	2	4	7	1	3	100	63	8			35 450	233	1	1 607	2
4151 Large spoon[13]	3	2	4	4	3	4	367	117	4			74 629	48 017	3	–	–
4156 Small spoon[13]	3	2	4	4	3	4	367	140	4	6(3)	1½	98 826	4 961	2	608	1
4161 Scraper[13]	4	4	4	4	3	4	367	144	4			119 765	26 668	3	–	–
4158 Jug	2	1	4	4	3	3	143	72	7	9(4)	1½	54 022	4 764	4	–	–
4219 Cutter[14]	2	8	4	4	3	4	90	47	5	4(2)	1½	162 492	188 261	4	–	–
8424 Mould[14]	2	8	4	4	2	3	108	26	6	5(2)	1½	122 472	95 994	4	–	–
4213 Holder	2	1	4	6	5	3	142	36	6	4(1)	1½	19 128	34 178	4	–	–
(F) General: Revised Product Concept																
2849 Hanger	3	12	6	3	–	5	183	50	9	11(3)	2	540 615	58 333	6	–	–
6049 Bracelet	2	4	6	2	22	4	74	74	–	2(1)	1	–	–	–	–	–

Notes

1. In the case of several of these products there is more than one moulding involved (for example, a body and a lid); here the principal moulding (for example, the body) has been analysed as representative.
2. If a product involves only one moulding, but there are (say) two or four impressions on the relevant mould, this means that such moulds have been designed to make the product concerned in (say) multiples of two or four, each time the moulding cycle is completed (the exception to this is given in Note 11).
3. Number of components refers to the number of different components used in assembling a product. The components will usually be purchased, and typically are metal fittings and other non-plastic parts.
4. If no production runs in the last 12 months, the last order has been taken as average.
5. Average production run has been taken over the last 12 months (see above).
6. Hours to change a mould includes changing the mould, then the time taken to get the mould working to production and quality requirements, which is shown in brackets. For example, Tray 1132 2(½) means 2 hours to change the mould and get it working to production and quality requirements. Of this 2 hours, the adjustment process to get it working to production and quality requirements after the mould change takes ½ hour.
7. The colours in stock are not the same as those required for outstanding orders.
8. The colour range of these products was increased from 3 to 8 as part of extending the 'revised product concept' to products of the 'original concept'.
9. This product was in fact packed in assorted colours and held in finished stock as such.
10. The range of colours for this item was due to the fact that customers tended to prefer their own colour for reasons of brand image, recognition, and so on.
11. New product range (outstanding orders represent initial launch).
12. Both these products are on the same mould.
13. These three products are on the same mould.
14. Impressions are of different shapes: two sets of shapes x 4 impressions.
15. The products shown here are considered to be representative of both their own and the total product range.

Exhibit 6 Cost details of representative products

Product details		Cost details (pence per 12)[1]							
			Labour				Overheads		
Range[2]	Item	Raw materials[3]	Moulding[4]	Assembly[4]	Packaging and components	Mould depreciation[5]	Moulding[6]	General[7]	Total
A	2225 Bowl	254	35	–	38	25	179	148	679
A	2687 Tidy	409	56	–	78	40	303	242	1128
A	2366 Bin	2103	142	–	272	160	787	957	4421
A	8282 Bowl	44	6	8	11	4	32	25	130
B	6491 Cap	9	–	–	1	1	15	8	34
B	8860 Tray	1621	88	–	668	116	491	695	3679
B	8009 Case	1093	73	–	515	83	406	496	2666
C	6246 No. 28	1799	110	103	435	280	609	839	4175
C	6846 Shelf	457	79	106	764	108	438	324	2276
D	5426 Holder	288	105	69	311	100	508	300	1681
D	5624 Holder	163	92	88	272	77	440	232	1364
D	6420 Mirror	1942	139	334	2469	317	773	951	6925
D	6428 Holder	578	165	76	786	173	812	518	3110
D	6606 Beaker	237	91	73	298	82	411	246	1438
E	8284 Large sieve	250	48	49	409	20	112	61	949
E	8424 Mould	21	6	10	17	6	29	19	108
F	2849 Hanger	54	4	8	18	4	21	25	134

Notes

1. 'Pence' – one penny = one hundredth of a £.
2. The product range abbreviations A to F are detailed in Exhibit 5.
3. Raw material costs are normally adjusted twice a year.
4. Moulding and assembly labour costs are based on calculated standard times.
5. Mould depreciation is a fixed percentage of the first stage costs, which comprises raw materials, moulding overheads, mould depreciation and moulding labour.
6. Moulding overheads are based on the machine size cost below:

Group	1	2	3	4
Moulding overhead allocation (£ p)	19.48	22.95	24.60	24.60

   If a product is to be moulded on a machine in Group 1, then the moulding overhead allocation will be based on £19.48, and so on. These allocations include indirect moulding labour, production staff, development, site, utilities, plant depreciation, blocks, dies and plant repairs.
7. General overheads are calculated as a fixed percentage of first stage cost.

Exhibit 7 Changes in components/packing, work-in-progress and finished-goods warehousing over the last seven years

Warehousing	Current year minus:	Size (square feet)	Distance (miles)	Total (square feet)
Components/packing	7	5 000	–	
	4	5 000	–	10 000
Work-in-progress	7	9 000	–	
	3	9 000	–	18 000
Finished goods	7	27 000	–	
	6	10 000	20	
	4	40 000	1	
	3	(10 000)	20	
	1	20 000	3	87 000

Then, the marketing department often requires additional colours in order to increase sales in existing markets or break into new markets [an example of such a request is shown as Exhibit 8]. These short runs and special colours often have target dates which necessitate fitting them in at all stages of the process at the expense of normal production runs. It is difficult to balance these two sets of priorities.

Marketing

The marketing department is split into product areas and subdivided into home and export. Each subdivision has a sales manager who reports to Mark Williams, the marketing director. Mark, who has been with the company for 12 months, confirmed that the change in product direction had enabled the company to compete successfully in a new sector of the market. 'Before I joined, the company had already achieved recognition as a front runner in this section, manufacturing high-quality, well-designed products. Frankly, this was one of the reasons I took the job.'

As Mark explained, the markets for the two products the company currently manufactured and sold were very different.

> Sales of the old product are normally negotiated on a large-volume contract, with call-offs to meet the agreed customer deliveries. In the new markets, retail outlets hold our ranges, but the mix of products and colours means that we often need to be able to supply orders within a few days. While this is not always possible, we have a good reputation from our customers for the level of support we provide. For, as they emphasize, if the exact product wanted by their customers is not available at the required time, then often the sale is lost as they spend their money on something else altogether.

Mark explained that he had continued to push this policy and had been instrumental in bringing out several new ranges since joining the company. The latest was

Exhibit 8 Production details for marketing samples in new colours

Product	Colour requests (units)					Actual time taken per product (minutes)[1]		Allowed moulding standard time per product (minutes)[1]
	Beige	Brown	Blue	Green	Total	Moulding	Colour change[2]	
4012 Dish	24	42	24	42	132	405	65	156
4013 Holder	20	42	24	42	128	550	100	152
4014 Beaker	24	42	24	42	132	480	60	111
4018 Holder	24	42	24	42	132	260	60	129
4019 Holder	24	42	24	42	132	670	110	132
4020 Sticks	40	42	30	42	154	270	60	137
4021 Ring	60	60	36	36	192	390	95	200
4023 Rack	20	36	20	24	100	1140	220	175
4028 Rail	24	42	24	42	132	445	60	139
4029 Frame	24	42	26	42	134	530	120	137
Total	284	432	256	396	1368	5120	950	1468

Notes

1. 'Actual time taken per product' is the number of standard minutes taken to mould the quantity of the product. 'Allowed moulding time per product' is the number of standard minutes calculated to mould the quantity of the product.
2. Colour change time is the total time taken to change from one colour to another in this production run. It is in addition to the actual moulding time given here.

due to be launched quite soon, with another due out early this year. 'This redirection has also had a few spin-offs in the older homeware range, where we have redesigned some packaging and increased and improved the colour range.'

Corporate Policy

'We have come a long way since those days of change', said Graham Brown, managing director.

> My predecessor had the foresight to rethink corporate policy when the group restructuring created the substantial excess moulding capacity. For the past two years, I have reinforced this sound strategy. The marked increase in sales is anticipated to continue, and home and export sales support this forecast. The lower-volume products have allowed us to gradually decrease our overall moulding capacity. It is now important that we use this capacity efficiently and, in making the budgets for the coming year, we have taken account of the anticipated non-productive demands on the manufacturing facilities. But although these new product launches make large demands on the system, they are our future life blood. We must keep costs down, and so look at all areas of costs. Our decision to go towards multi-impression moulds is one way of staying competitive [see Exhibit 9]. Our recent and future product ranges reflect this perspective.

Exhibit 9 Technical note

Multi-impression moulds

An important design decision to be made concerns the number of impressions to be built into a mould. A single impression would mean that with every shot only one moulding is produced. With multi-impression moulding, then two or more products (depending upon the number of impressions) are made with every shot, thus giving a significant decrease in moulding time to complete an order quantity. This could be a lid or base of the same product, two lids and two bases of the same product, two or more identical products (such as trays), or two or more products that are not identical (such as a set of spoons to be sold as a set), or two or more different products to be sold as different products in the marketplace.

- Normally the number of impressions are even-numbered to retain balance in the mould.
- The capital cost of a two-impression mould is more than twice the cost of a single-impression mould of the same item due to the increased complexity of the mould design.
- The more impressions per mould then the larger the mould size (that is, physical dimensions) and the longer it takes to set up and colour change.

Moulding machine

With wear and tear over time, moulding machines increasingly find it more difficult to achieve the upper limits of their specification. One common problem is that when the raw material is injected into the mould under pressure, then the machine is less and less able to exert the locking pressure necessary to keep the two halves of a mould together. If it does not, then flashing will become apparent. If flashing does appear, with a low-quality item it can be trimmed off, with a high-quality item, this would normally make it a reject.

Moulding

A mould can go onto any machine, providing that the machine is physically large enough to take the physical dimensions of the mould, has the shot weight to fill the mould and hence produce a complete moulding and has the locking pressure to keep the two halves of the mould closed during the machining cycle.

Hence the division of moulding machines into four groups reflects the fact that machines are in a range of 'sizes' (that is, physical dimensions, such as the opening to take the mould, shot weight and locking pressure). Moulds, therefore, are loaded according to the appropriate machine size. There is little opportunity to sensibly transfer one mould to another machine group.

Finally, the size of a mould is primarily a factor of the dimensional size of the product (that is, height and diameter). Similarly, the moulding cycle time (how long it takes a machine to inject material into the cavity of the mould) is a factor of product size, the wall thickness of a product and, to a much lesser extent, the condition of the machine (that is, the effects of wear and tear).

Note

1. Cycle time is the length of time it takes for the machine to close the mould, inject the material, initial cooling, open the mould and present the moulded part for the operator to remove from the mould. In many instances, a mould is so designed as to complete this last operation on a part or wholly automatic basis.