Case study 10

Holmgren Engineering

> Thanks for detailing your findings, Peter. As we've all had copies of your report for some time, I now suggest we open up the discussion on your proposals.

John Svensson, CEO of Holmgren Engineering (HE), was addressing the management team following Peter Wiklund's presentation on his proposed changes to the layout and process for the future manufacture of the Hetvatten range of products.

Background

Holmgren Engineering (HE) was established almost 40 years ago. Initially it was a small heating engineering firm started by Benny Holmgren offering a range of related services. It grew and later expanded into manufacturing its own products. It continued as a family business until it was taken over some 10 years ago by Karlsson Invest, a conglomerate with a range of businesses involved in building and construction-related activities. The last few years have seen a continued increase in sales although there has been a slight fall-off in profits (see Exhibit 1).

Based in Halmstad, HE is in the industrial conurbation centred on Gothenburg in southwest Sweden (see Exhibit 2). Although initially an installer of equipment and provider of support services, HE is now only involved in the manufacture and selling of water storage systems. In fact, since it was taken over by Karlsson Invest it has moved even more into

Exhibit 1 **Sales revenue, EBIT[1] and inventory data – current and past two years**

	Current year –2	Current year –1	Current year
Sales revenue (index)	100.0	111.5	125.6
EBIT (% sales revenue)	10.3	8.6	7.4
Inventory (SKr000)[2]			
• raw material and components	3,144	5,052	5,352
• work-in-progress[3]	180	144	168
• finished goods	720	924	1,680
Total	4,044	6,120	7,200

Notes 1 EBIT = earnings before interest and tax.
2 SKr = Swedish krona.
3 Work-in-progress includes issued materials and part-made products.

Exhibit 2 **Outline map of Northern Europe**

Key
A = Austria
B = Belgium
CH = Switzerland
CZ = Czech Republic
DK = Denmark
NL = The Netherlands
SL = Slovak Republic
UK = United Kingdom

developing and manufacturing water storage products which include mains pressure heating systems.

Products

HE manufactures a range of products on its Halmstad site. The part of its range addressed by Peter Wiklund's report is sold under the Hetvatten Plus trademark. This comprises a family of products which vary by size of heating coil and storage capacity (see Exhibit 3). These products are sold throughout Sweden and parts of Europe. Normally, the delivery lead time is three to four weeks, but shorter deliveries can usually be met where necessary.

Operations

The Hetvatten Plus product range is basically made to a standard design and configuration. Larger houses and growing demand for hot water has led to an increase in the product range over the last decade. However, in operations terms, the current range is not difficult to handle. The principal changes concern the external dimensions of the product and the different sizes of heating coil. But these require few, if any, alterations to the basic design.

The present layout and other related cost information are given in Exhibits 4 and 5. Currently, products are made in order quantities of five. As shown in Exhibit 4, an order quantity moves through the different processes, with the tasks completed on all five products before the total order quantity is moved to the next stage.

Exhibit 3 **Hetvatten Plus product range**

Model	Storage capacity (litres)	Dwelling types			Dimensions height × width (cm)
		# bedrooms	# baths	# showers	
A	120	2 or 3	1	–	1500 × 500
B	140	2 or 3	1	1	1500 × 550
C	160	2–4	1 or 2	1 or 2	1500 × 600
D	180	3–4	1 or 2	1 or 2	1600 × 600
E	200	3–5	2	1–3	1700 × 600

Exhibit 4 **Present factory layout**

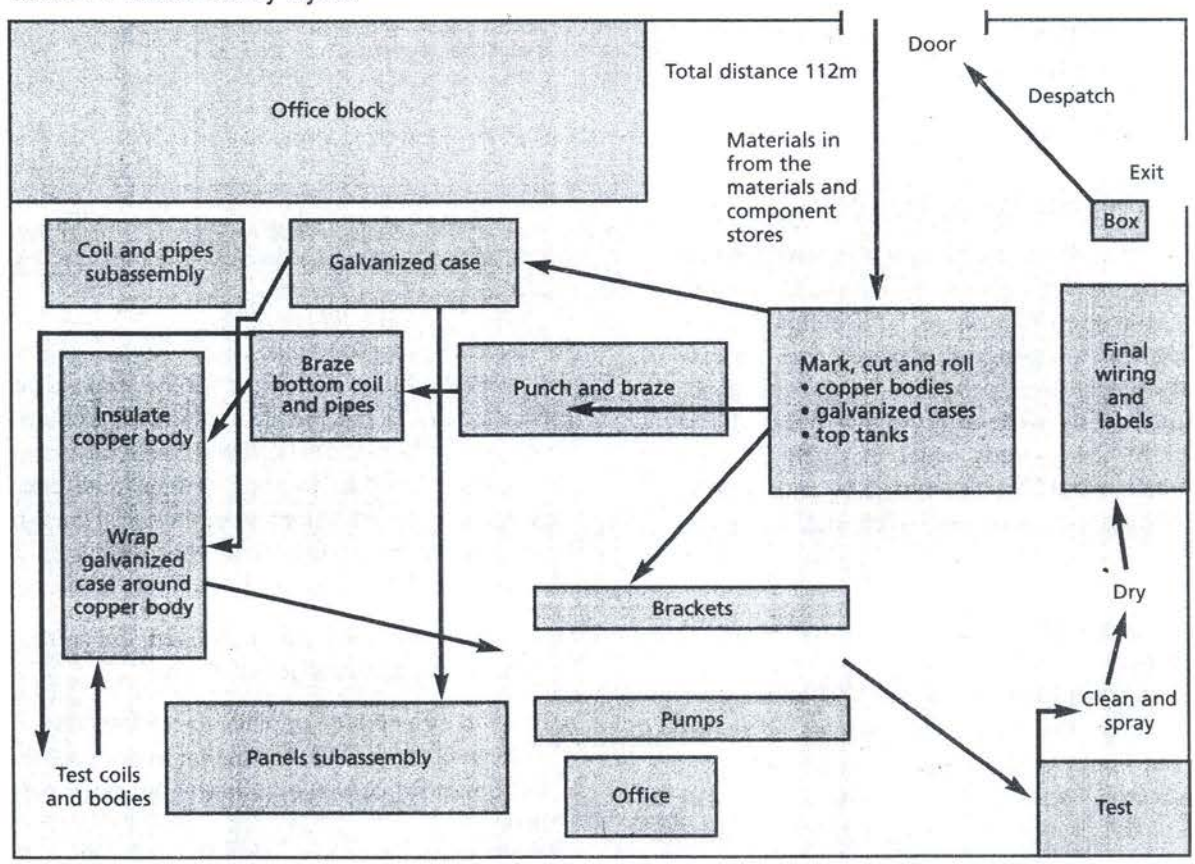

Exhibit 5 **Costs (SKr) per unit**

	Category	Models				
		A	B	C	D	E
Cost per unit	Material	4,200	4,800	6,360	7,068	7,908
	Labour	1,260	1,284	1,320	1,464	1,656
	Overheads	900	900	900	900	900
	Total	6,360	6,984	8,580	9,432	10,464

Note 1 Costs are based on an average weekly production of 100 units.

Operations scheduling

The production programme is agreed weekly. Based on known orders and forecast sales it looks four weeks ahead, with week 1 fixed and weeks 2–4 tentative.

Currently, parts are bulk ordered, with weekly call-offs agreed at the beginning of each month. Most material and components are delivered on the first day of each week, with sufficient parts for the production planned for that week, and held in the material and components stores, which is located on the same site but in a different building from the one outlined in Exhibit 4.

Working on agreed weekly schedules (see Exhibit 6), materials are issued to the production area on a daily basis.

Exhibit 6 **Production figures for weeks 11–18 of the current year**

Models	Units produced in the following week #							
	11	12	13	14	15	16	17	18
A	10	15	10	10	10	10	10	15
B	15	15	10	10	10	15	10	15
C	40	40	40	30	40	40	40	40
D	30	30	25	20	35	30	30	30
E	5	5	10	10	5	5	10	5
Total	100	105	95	80	100	100	100	105

Notes 1 The above production figures are representative of the mix of models produced in the current year.
2 Issues to the shop floor are in order quantities of five.
3 The number of boilers is based on the planned capacity within a week and the mix of boilers scheduled to be manufactured.
4 Week 14 included a public holiday and, therefore, comprised only four working days.
5 All products are included in figures for the week in which they were completed. Therefore, no part-made boilers are included in the above figures.

Production engineering report

The report presented by production engineering reviewed the current operations procedures used to make the Hetvatten Plus range. Its principal recommendation was to change the layout and the way of manufacturing these products. In essence, products would now be made in order quantities of one compared to the current order quantity of five. Also, products would be transferred by rollers, with staff pushing them from one work station to the next.

Overview of the proposed changes and benefits to be gained

On John Svensson's invitation, Peter Wiklund gave an overview of the proposed changes and also detailed the benefits to be gained. Using an overhead projector, Peter explained the detail and rationale of the proposals and highlighted the benefits that would result. What follows is a summary of Peter's presentation and the key points of clarification requested by those at the meeting:

> As you know, a typical boiler comprises four principal subassemblies – copper body, top tank, galvanised casing and the electrical unit. As shown in the current layout [see Exhibit 4], these subassemblies are produced in separate systems and come together, as required, at the assembly stage. You can also see from the layout details that the distance travelled totals 112 metres.
>
> One of the initial tasks was to evaluate the current system and propose changes on whether to:
>
> - make-to-order (MTO) or make-to-stock (MTS)
> - make in order quantities (whether five or a different quantity) or make individually (one-piece flow)

- hold stocks of subassemblies or make them as part of the final product assembly stage.

To help in this evaluation, we used Exhibit 7 which also gives the agreed scores on each dimension for the eight options.

My recommendation, in the first instance, is to adopt option 7 [Exhibit 7], as holding subassembly stock will take some pressure off the system. Later, when the revised arrangement is running well, we can eliminate this feature. [Details of the revised layout and other changes are given in Exhibits 8 and 9.]

However, to be able to change successfully to the new way of working will require a number of tasks to be completed. These are listed in the report distributed earlier [see Exhibit 10]. Once the changes have been implemented we expect to gain the following advantages.

Peter then went through the list of advantages listed in Exhibits 11 and 12 and explained each in full.

Given the need to improve our overall performance and the premium we are giving for reducing costs and taking out overheads, I feel that these changes are ones which will, in themselves, lead to noticeable inventory reductions, additional floor space needed to make new products in the future and shorter manufacturing lead times for the Hetvatten Plus product range. For these reasons I wish to implement these proposed changes as quickly as possible.

Questions

1. Examine the current operations process used at Holmgren Engineering. What are the key features of this way of making products?
2. What are the key changes that enable the proposed method of production (one-piece flow) to work?
3. Evaluate the benefits of these proposed changes and highlight the principal gains to be made.
4. What factors would need to be carefully managed to ensure a successful implementation of these proposals?

Exhibit 7 **Evaluation of alternative approaches to manufacturing, used as a basis for selecting the changes to be introduced**

#	MTO versus MTS[1]	Batch size	Sub-assembly stock yes (✓) or no (✘)	Dimension and score (1 = good; 4 = poor)						Total score
				Efficiency	Inventory	Speed of throughput	Space/ movement	Response/ variability	Quality	
1	MTS	5	✓	1	4	3	4	3	4	19
2	MTS	5	✘	3	3	4	3	3	2	18
3	MTS	1	✓	2	3	1	2	3	2	13
4	MTS	1	✘	4	2	2	1	3	1	13
5	MTO	5	✓	1	3	3	4	1	4	16
6	MTO	5	✘	3	2	4	3	1	2	15
7	MTO	1	✓	2	3	1	2	1	2	11
8	MTO	1	✘	4	1	2	1	1	1	10

Note 1 MTO = make-to-order; MTS = make-to-stock

Exhibit 8 **Proposed factory layout**

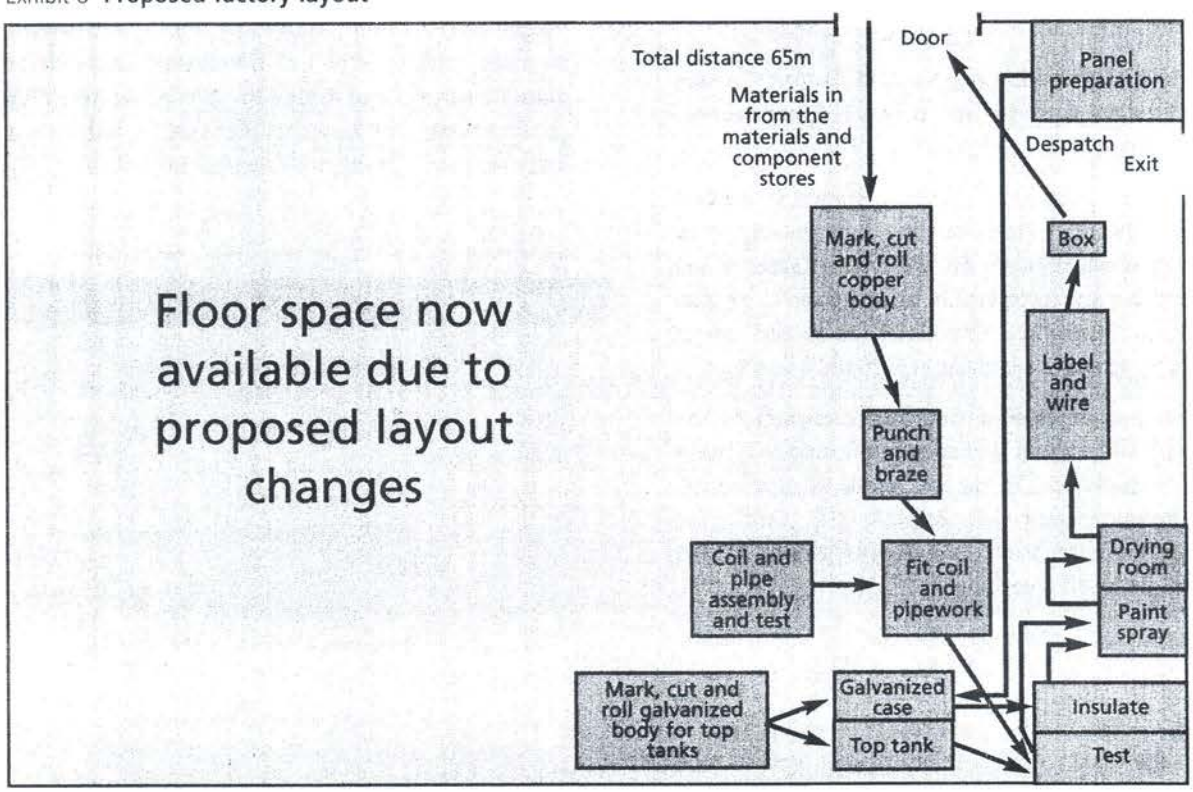

Exhibit 9 **Summary of proposed operations changes for the Hetvatten Plus product range**

The changes proposed and the principal benefits resulting from them have been summarized below:

Current operations

- Currently Hetvatten Plus products are made in order quantities of five.
- All five products go to operation 1 where the work is completed before all five products go to operation 2 and so on through the entire process.

Move to flow production

- Under the 'flow' production system, batches of five will be eliminated and work will be carried out on an order quantity of one.
- The physical structure of manufacturing will be altered to a U-shape production line (Exhibit 8).
- Single boilers will be moved on trolleys around the line.
- Subassembly components will be made off the main line and added to the part-made boiler on the line.
- A JIT process will be set up for raw material suppliers from stores to the line, and a JIT process will operate with component suppliers.

Human resource changes

- Currently operators concentrate their work on one area, but may be required to assist on different sections, or move to the subassembly area if the preceding stage is longer and holds up production flow.
- In the process flow system, there will be less need for operators to move around. They will be assigned specific tasks and will keep to that operation through the day (this may consist of two or three steps). This should improve productivity as there will be less time lost through walking about. However, the new U-shaped flow system enables operators to maintain eye contact and allows each operator to have a better view of the whole process.

Exhibit 10 Tasks to be completed as part of the change to one-piece flow production

Before the move to the one-piece flow production, we need to undertake the following tasks:

1. Remove changeover times (particularly on punches).
2. Estimate the need for any two-man lifting requirements.
3. Develop a U-shaped manufacturing layout to minimize distances between operations.
4. Position tooling and materials close to the relevant operations.
5. Establish standard work methods.
6. Balance the line capacity.
7. Encourage teamworking, particularly through a new payment system, setting consistent performance targets and adopting a different management style.
8. Reduce or eliminate delays in spray painting.
9. Control dust from the rockwool insulation operation.
10. Possibly eliminate the final water test.

Exhibit 11 Advantages of the one-piece flow process

1 **The advantages accruing from 'one-piece flow' are that it:**
- reduces the floor area required, with the freed-up space being used for the manufacture of a new product
- increases quality
- facilitates teamworking
- reduces the walking distances involved
- increases flexibility
- reduces work-in-progress (WIP) inventory
- leads to higher control of throughputs
- increases focus for the continuous improvement teams
- improves operator's overall vision by means of the U-shaped layout

2 **The advantages accruing from making-to-order as opposed to making-to-stock are:**
- lower finished goods inventory
- increased flexibility in production planning
- lower raw material inventory
- ability to cope with higher product variety
- materials can be delivered directly to the work stations

3 **The advantages relating to the presence of subassembly inventory within the process are that it:**
- facilitates labour balancing
- affords the opportunity to make and feed parts to the point of use
- enables faster throughputs
- improves inventory control with the use of *kanban* systems

Exhibit 12 Specific advantages to be gained from the proposed changes in operations

The advantages accruing from the proposed changes in operations include:

1 **Reduction in labour content** – less walking due to the smaller working area under the revised conditions.

2 **Elimination of set-up times** – the purchase of additional equipment (see Exhibit 13) means that set-ups will be eliminated.

3 **Reduced tooling costs** – the elimination of tool changes (see 2 above) means that some SKr 36,000 of tool damages per year would also be eliminated.

4 **Raw material inventory** – it has been agreed to change the call-off arrangements with suppliers. Materials (and particularly the high value items) are to be delivered more frequently. However, it is intended to hold raw material inventory steady even though sales revenue will increase in the next year by 44 per cent. Later it is intended that the supplier delivers some items (particularly the high value items) directly to the line on a daily basis.

5 **Work-in-progress inventory** – with the reduction of batch sizes from five to one, work-in-progress inventory will be reduced to SKr 36,000.

6 **Finished goods inventory** – the orientation of the company from a make-to-stock to a make-to-order approach will result in the finished goods inventory ceiling being reduced from a high of 1750 units (equivalent to SKr 10,500,000) to a maximum of 300 units (equivalent to SKr 1,800,000).

7 **Floor space** – the change in order quantities from five to one will result in a 50 per cent saving in floor space (see Exhibit 8).

8 **Distance travelled by a typical product** – resulting from the floor space gains, the product in future will travel 65 as opposed to 112 metres (see Exhibits 4 and 8).

Exhibit 13 Additional equipment investment

As part of the shop floor changes, the following additional equipment was purchased in order to reduce material movements, the time of operations and the number of set-ups involved

Equipment description		#	Costs (SKr)	
			Per unit	Total
Folding machine		1	30,000	30,000
Roller		1	18,000	18,000
Punches	small	3	7,200	21,600
	large	1	9,600	9,600
Fly presses		2	9,600	19,200
Air test unit		1	18,000	18,000
Jenny		1	1,200	1,200
Lifting table		1	18,000	18,000
Create test area, introduce racking/storage bins and other layout changes		1	12,000	12,000
Total		**12**	–	**147,600**