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MANAGEMENT ACCOUNTING PRACTICE AND PRICE CALCULATION: SOHO FOUNDRY

by

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Abstract

When deciding upon the price to charge for one of their products the managers of the Soho Foundry in Birmingham placed great reliance upon the data stored in their accounting system. By the last decade of the eighteenth century the nature of the steam engine business was changing rapidly and reputation alone was insufficient to attract customers. Also as more industrialists decided upon steam as a source of power and competition to supply their needs more attention had to be paid to price structures. As well, increasing standardisation of product meant that a price list could be determined. This paper addresses the processes undertaken at the Soho Foundry to establish price lists for engines and parts.

November 1995

MANAGEMENT ACCOUNTING PRACTICE AND PRICE CALCULATION:

SOHO FOUNDRY

Introduction

The manufacture of steam engines in the late eighteenth century was a highly competitive business and while the Boulton and Watt organisation tended to compete on quality and reputation rather than prices it did pay attention to costs when working up a price for a potential customer. It is the aim of this paper to examine the calculations undertaken in the process of price determination at the Soho Foundry.

The first part of the paper provides a background to the second part, which is concerned with price calculations.

The Steam Engine Business

The original partnership of Boulton and Watt, formed in 1775 was established to act as consulting engineers in the erection of steam engines [Roll, 1930; Dickenson, 1935; Tann, 1981; Law, 1990]. The steam engine developed by James Watt was more efficient and economical than the other engines then available. As most of the engine parts were made by subcontractors, Matthew Boulton and James Watt selected appropriate specialists for particular pieces, and because of a concern for the firm's reputation these subcontractors were selected more on the basis of the quality of their work than cost [Tann, 1981]. However as time went by, in order to maintain the high quality of the product, more and more parts were made in Boulton's Soho

Manufactory, until by the early 1790's over 50% of the value of the engines was made by the partners [Tann, 1981]. The nature of the business was changing as well, with customers being more interested in purchasing a complete engine rather than being bothered with the close involvement in its construction that had been necessary to this point [Dickenson, 1936]. Other incentives that inclined the partners towards manufacture in their own right included the attraction of a greater share of the profits, hitherto being taken by the sub-contractors. There were problems too with quality control and lack of standardisation, together with the difficulties in coordinating the sub-contractors [Tann, 1981]. Sub-contracting did have some benefits though. The major one being that all the engines were custom built and the sub-contractors bore a large part of the risk.

By late 1794 Boulton and Watt had come to the view that they would have to manufacture complete steam engines and not depend on subcontractors. In October a new partnership under the name of Boulton, Watt & Sons was formed [Roll, 1930; Dickenson, 1935; Tann, 1981]. The partners were Matthew Boulton and his son Matthew Robinson Boulton, James Watt and his sons James Watt jnr and Gregory Watt[1]. The purpose of the new partnership was the manufacture of steam engines, thus completing Boulton's promise of 1769 to build a factory for this purpose [Dickenson, 1935; Tann, 1978]. Roll [1930] suggests four reasons for the establishment of the factory, to be known as the Soho Foundry, in 1795:

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[1] Gregory Watt (1777-1804) was a half-brother to James jnr. Always suffering poor health, he died of consumption at the age of 27 [Rolt, 1962].

1. The steam engine patent as extended by the Act of 1775 was due to expire in 1800 and the mounting incidences of piracy of their engine design indicated that there would be intense competition after the monopoly was removed. This impending competition meant that the firm would have to concentrate on efficient methods of production and competitiveness.
2. Success had ensured an adequate supply of capital to finance a new production facility. There was also available a pool of workmen skilled in the production of the various parts of steam engines.
3. Matthew Boulton was 66 years old and James Watt was 58 and both, wishing to pursue other interests, were ready to hand over to their sons.
4. Perhaps the most immediate reason was the disagreement between John Wilkinson and his brother William[2] resulting in a court order to close the Bersham Ironworks, a situation which was potentially disastrous as Wilkinson was the major supplier of cast iron cylinders and other castings. Other foundries[3] could not match the quality of Wilkinson's work.

There was no formal legal agreement for the establishment of the 1794 partnership so it is not possible to determine how it was intended to operate [Gale, 1962]. It is obvious from the way that the business was conducted that the sons were to be given freedom in their management of this new direction. The elder Watt was not involved

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2 Matthew Robinson Boulton married William Wilkinson's daughter. William Wilkinson gave advice on the setting up of Soho Foundry [Roll, 1930; Rolt, 1962; Gale, 1962].

3 Cylinders cast and bored by the Coalbrookedale Company were reasonably satisfactory but they were unable to meet the demand and cylinders produced elsewhere were unsatisfactory [Rolt, 1962].

apart from advancing finance to buy land and giving advice, he being more concerned with his scientific pursuits [Dickenson, 1935]. Once the new partnership had been formed the first step of note

> ... was to decide on the building of a completely new works solely for the manufacture of engines and, having decided, to set about the task with a speed and energy which was entirely characteristic of the younger partners. It was a most important decision. Engines had, of course, been built for years, both by Boulton and Watt and latterly by numerous others, but nobody had, so far, put down a factory designed, built and equipped with that one end in view. Here, then, was a new conception. It could reasonably be called the world's first purely engineering works.
>
> [Gale, 1962, p. 76]

Soho Foundry

The name given to the new works was the Soho Foundry and it was intended from the outset to be run as a separate business by Matthew Robinson Boulton, James Watt jnr, and Gregory Watt. The opening of the foundry meant that they would be complete engine manufacturers. Construction began in 1795 and was complete in 1796 [Roll, 1930; Dickenson, 1935; Gale, 1962; Tann, 1981].

The Foundry was sited on 18½ acres in Smethwick, next to the Birmingham and Wolverhampton Canal. The layout of the works received close attention being designed to take advantage of the natural fall in the land. Following the advice of experienced engineers such as Peter Ewart and William Wilkinson the buildings were "extensive and included a foundry with air furnace and core-drying kiln, forging shop, smith's shop, boring mill, turning shop, fitting shop and carpenter's shop" [Rolt, 1962, p 119]. This establishment was important because it was the first facility ever

built for the purpose of building steam engines and offered greater efficiency of production over other manufactories that had been adapted for the purpose. The Soho Foundry was a product of remarkable skill and foresight [Gale, 1962].

The buildings were designed to take account of the natural fall in the land which assisted in the removal of the cylinders from the casting pit down a slope to the boring mill "(h)ere was a natural flow-line process, with no unnecessary material movement, in 1795!" [Gale, 1962, p 79]. Similar attention was paid to the siting of the other items of equipment and ancillary buildings, with the aim of achieving efficient production.

The foresight and planning that had gone into the building of the Soho Foundry is evident from a description of the Foundry by Shaw in his *History of Staffordshire* (1798-1801) who observed that

> ... Messers. Boulton & Watt found it necessary to erect and establish an iron foundery for that purpose [manufacture of steam engines] and they have accordingly in partnership with their sons (to whose activity, genius, and judgement it must be attributed, that this great work was begun and finished in the course of three winter months) erected at a convenient place and contiguous to the same stream at Smethwick a great and complete manufactory and foundery into which a branch from the Birmingham Canal enters and thereby the coals, pig iron, bricks, sand, &c. are brought and their engines or other heavy goods are transported to every part of the kingdom, their being a wet dock within their walls for four boats to lie.
>
> [quoted in Roll, 1930, p 161]

The Soho Foundry was opened in January 1796, an occasion celebrated by a luncheon for 200 guests [Roll, 1930; Rolt, 1962]. Many former Bersham employees were engaged to work in the new factory including Abraham Storey who was appointed the

foundry foreman [Dickenson, 1935; Rolt, 1962]. The new factory did not manufacture all of the engines that the firm sold as the records indicate that Boulton's Soho Manufactory continued to assemble engines and make parts of engines for a number of years even though the Soho Foundry was manufacturing complete engines.

In its first year of operation the Soho Foundry accepted orders for 31 engines and by 1800 had produced 169 engines [Tann, 1981].

Matthew Robinson Boulton seems to have been very much involved in the initial planning for the Foundry while James Watt jnr, judging from the amount of calculations and costings in his handwriting, seems to have been more concerned with the daily organisation and running of the business [Dickenson, 1936]. In a letter to a friend on 14 April 1797, Matthew Robinson Boulton said:

> You will (not be a) little surprised to find that I am a very regular attendant in the counting house & immersed in business. Like a person hesitating on the brink of a cold bath I found that the only means of conquering my aversion was to plunge in; my experiment has so far succeeded. Mr. J.W. jun^{r}. & myself with the occasional advice of the old gentlemen have the entire Management of the Engine business & for the last 12 mos. I have not had respite from it as you will judge from the epitome of our labours.
>
> [Tann, 1981, p 235]

The Organisation of the Soho Foundry

The Soho Foundry had three main operating departments. The Foundry Department was responsible for the casting of engine parts, the Smithy Department was responsible for the manufacture of parts from wrought iron and the Fitting Department was responsible for machining the parts and fitting the engine together. As mentioned

above, engines continued to be built at the Manufactory, with the products of both establishments being sold by the one organisation, however, the records make a distinction between the products of each. The Soho Foundry was operated as an independent entity and was expected to make a profit; as were each of its operating departments which were treated as profit centres.

Prices

Originally, the older Watt and Boulton charged a yearly premium for their engines rather than a straight forward price, because they supplied the knowledge to build the engine rather than the individual parts. When first introduced, the premium was based on the savings in coal usage which resulted from the more efficient Boulton and Watt engine compared to the older atmospheric steam engine[4]. As the organisation supplied more and more engine parts, it charged for those parts supplied plus a yearly premium or royalty. Eventually, when the organisation was supplying the whole engine it became obvious that the pricing system was inadequate.

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[4] Watt snr carried out a number of experiments to determine the relative efficiency of various sizes of engines and developed a calculation to enable him to determine the premium payable on any one engine. To decide the actual premium in any one year it was necessary to determine the amount of work done so he invented a device to count the strokes of the engine [Rolt, 1962; Dickenson, 1935]. Eventually, the premium was calculated by using a formula based on horsepower [Fleischman & Parker, 1992]

The price to charge seems to have been a continual problem to James Watt jnr and Matthew Robinson Boulton. Increasing competition, coupled with the fact that the annual premium was never popular with the customers, meant the partners had to pay strict attention to pricing. It was no longer sufficient to trade on quality alone. Also the firm had to be sure that they recovered their costs as they were now supplying complete engines. The change from charging an annual amount to a straightforward price also required a change in methods of calculation. To this end engine cost became the basis for price calculation.

There was a common pricing structure for the engines they built, whether they were built at Soho Foundry or assembled at the Soho Manufactory. Prices were constantly in their minds as can be seen from the considerable correspondence and calculation on the subject. The first word came from the elder James Watt in a letter to Matthew Robinson Boulton.

Soho June 1st 1796

Mr M. R. Boulton

Dear Sir
As your father & myself considering the general subject of premiums it appeared to us that they might with propriety be charged as follows taking Mr Southern's[5] estimate of 12 horse engine for an example

neat cost materials		£308	
manufacturing profit 20 pr%		68	
Premium 50 pr Ct on neat cost		154	
Boiler			60
10 pr% on	Do	6	

5 John Southern (1758-1815) joined Boulton and Watt as an assistant draughtsman in 1782 and remained with the firm until his death in 1815. He was a trusted and valued friend and employee, he was admitted as a partner in 1810. Southern is reputed to have invented a device for measuring changing cylinder pressures in 1796 [Rolt, 1962; Roll, 1930; Dickenson, 1935].

		£596
		------
or if you think that is too little		
materials & 20 p^{r}%	376	
premium 50 p^{r}%		188
Boiler + 10 p^{r} cent	66	

		£630

We think that we have no title to 50 p^{r} % on boilers not being made by ourselves, there is little besides the risk of bad debts - however we wish to leave the whole open till we are all at home, & I think it cannot be satisfactorily settled till there is a view of this years transactions & profit, at present it is better to ask something too much than too little.

Small engines should pay a greater percentage than larger ones, otherwise will be attended with loss, as requiring so much trouble, we should look now to the conclusion of the patent & when all settle prices settle also what we can probably work for when that is required.

I have no news since my last & remain
Dear Sir
Yours affect^{ly}
James Watt

[B&W D/1]

While having an appreciation of the direct cost of manufacture the letter indicates an unsureness about indirect costs with the markups of 50% on cost as well as an allowance for manufacturing profit. By this time James Watt snr was acting in an advisory capacity to the others.

The young partners were obviously sensitive to public opinion as the following extract from a letter from Watt jnr at Newcastle to M. R. Boulton on 10 th July 1798 where he wrote that the

> ... opposition we experienced from Murray[6] at Leeds, that attempted by Hawkes here & the report generally prevalent & generally accredited of the enormity of our profits upon Rotative Engines, make me think

---

6 Matthew Murray manufactured engines in Leeds, Boulton and Watt had suspicions that Murray had infringed the patent but took no action against him until after 1800 when they opposed his patent application [Tann, 1980].

> seriously that we ought at an early period, perhaps at the close of our books in Sep[r] to adopt a new Tarif of Prices. If the present premium on Rotatives were reduced to 30 per %, we might keep it at that rate for a few months & then reduce it farther if judged eligible. It should also be an object of consideration, whether the Londoners should not be put upon the same footing with their neighbours in the Country. Perhaps 25 per % might be advisable for Colliery Engines, in order still to keep up some distinction between them & others as arising from the very great difference of the value of savings. It will be prudent in us whilst we yet may, to secure the trade in our own hands, by removing in part the incitement to rivalship & bringing matters to that state, in which we can still carry on the business with a reasonable profit after the expiration of the patent.
>
> [B&W E7]

They were concerned with mark up on cost. It must be remembered that at this point in time each engine was built to the requirements of the customer, however there was considerable standardisation of engine components and so a standard price could be set. Whether to charge a different price to customers in London was a question they struggled to answer and was one which was not resolved for some time.

James Watt jnr proposed a differential price structure in a letter to Boulton jnr a couple of months later when he wrote:

Horses	Country	London	Add[l] Boiler
4	£350	£366	£32
6	£379	398	38
8	473	497	45
10	523	548	60
12	560	588	68
16	727	763	90
20	800	840	110
24	1040	1092	132
30	1120	1176	160
32	1156	1214	172

M R Boulton
Scarborough

Soho 11 Sep[r] 1798

> Above you have a synopsis of the new Estimates. They may reckoned to take place in all Engines sent from hence after the end of the present Month.

In framing these, the old estimates have been left quite out of the question & we have proceeded upon what appeared to be the real costs by Foreman's books. These we have determined by taking out all those of a size that have been made since the prices were raised & the steam cases added; we have then deduced an average cost and added about 5 per % to cover deficiencies & to provide for trifling additions either in the way of improvements or extraordinary size of Rotative Shaft & c. The Boilers have been taken as they stand charged in Foreman's books (where a profit of 16 per % is already laid on by the Manufactory, which considering the little trouble we have with them is enough on that score) and their average amount has been added to the sum obtained as above for metal materials. This has been assumed as the full cost & to it has been added 33 per % for the country prices & 40 per % for London.

An example will make this more clear.

The Average Cost of the MM of a 4 Horse Eng.	£220
5 per % about	£ 10
Foreman's charge for Boiler	32
Total manufacturing cost	£262
Country premium 33 per %	88
New Country Price	£350

If the boiler is not to be furnished by us you deduct its cost as stated in the fourth column & we remain in proportion of the percentage charged for Premium. This appeared the simplest mode of proceeding - The London prices have been calculated at 40 per cent. It was thought advisable not to bring them down at once to the country prices, but to lessen the disparity gradually; the one is therefore reduced 17 & the other 23 per % -

Perhaps upon comparing these with the old prices, you may not think we have taken off enough; neither do I. But it may be well to go to work gradually, to try these for half a year & then perhaps to come down to 25 per % on the Country & 33 on the [London]

I have also to add, that Southern otherwise engaged, these estimates have been taken somewhat grossly and will admit of revisions and corrections when we are all together. For the present, they are on the safe side.

[Signed] J Watt junr.

[MBP 353/61]

These prices were based on costs in the Manufactory, but as stated above they applied to those engines produced by the Foundry as well. The term MM refers to metal materials, ie. the cost of the various parts and the assembly of the engine.

The following extract indicates further concern with public opinion as well as the effects of increasing competition. Boulton & Watt engines enjoyed a considerable

reputation for quality, but they were expensive and there were a considerable number of other manufacturers in the market, who did not offer a product comparable in quality, but one that nevertheless met most of the customer's needs at a lower price.

In a letter to James Watt jnr, who was in London dated Soho December 18 1798, Matthew Robinson Boulton wrote that he would

> ... if possible get an estimate [of brass air pumps] & forwarded by this evening's coach & shall accompany it with a new list of prices of Engines - we find that considerable embarassment will ensue unless the reduction of our estimates is made very gradually the whole reduction proposed to take place before March 21st 1799 viz from 45 pr% to 33 on London & frm 33 to 25 pr% on country we think should be effected by monthly deductions - without this precaution we shall have much difficulty in stearing clear of Disputes upon this subject & certainly not succeed in accomplishing the alteration witht exciting public attention ...
>
> [B&W 38/4]

A second letter to Watt, written later that day, lists the proposed prices with the further proviso that the premium be reduced on a monthly basis and stressing the need for gradual reductions. He wrote:

> I send you herewith the prices referred to in my letter of this morning & we propose them for the ensuing month to be stated at one pr % less or at 34 & 28 pr % upon metal Masters & similar reductions to take place monthly till we arrive at the permanent standard - Perhaps it may be judged expedient to make a larger deduction from the London prices in order to bring them sooner to the same standard as the country. From your recent transactions with the Londoners you will be enabled to judge whether this distinction has or is likely to create any disatisfaction & of course to decide upon the propriety of extinguishing it more rapidly ...
>
> [B&W 38/4]

Watt jnr's reply came from London a few days later when he responded that he could not

> ... help thinking that the proposed monthly reduction will be troublesome & create some confusion with respect to orders

> transmitted by Lawson, or any other itinerant agent. The further reduction to be made at 4 p^{r} % in one instance & 10 in the other is so small, that I do not fear its having the effect you apprehend, more especially as the last very considerable reduction was not attended with such consequences & appears indeed to have escaped observation. I should either propose to continue the estimates you now give, for six months, & then take 4 p^{r} % from the Country & 5 p^{r} % from the London price. The remaining 5 might remain upon the London Engines until this time twelvemonths. I presume you have not yet made <u>new</u> Estimates, nor do I think you can, until several Engines have been made with the proposed alterations, which I hope you are now carrying into effect. They will add to the price considerably, unless deductions can be effected in other matters ...
>
> [B&W E/7]

On the eve of the expiry of the engine patent Watt jnr was still concerned with the image of the firm conveyed by the pricing structure as well as with dealing with the opposition. On the 24th April 1799 in a letter to John Southern on the question of prices and quality Watt wrote:

> I think the estimates you propose sending to M^{r} Tewsbury very proper, and I also think it very right that the topics you state should be urged at some length, particularly that our prices now, comprehended nothing but a manufacturing profit & will not be effected by the expiration of our exclusive privilege. That it is not our wish to vie with others in lowness of estimates, but in goodness of workmanship, being well connvinced by long experience that the best Engines are the cheapest in the end. ...
>
> [B&W 33/5]

Even though the generally held view was that Boulton and Watt engines were the best available, Watt jnr kept his eye on the market realising that many potential customers were prepared to compromise quality if substantial cost savings were to be made.

In attempts to set a price for the different sizes of engines Watt continually referred to the cost of engines already built as they were listed in the engine book rather than base cost on a 'standard' engine for each capacity. The following examples are taken from a document entitled "Calculations for new Estimates 4th June 1801" and illustrate the

calculation of price based on past cost, the document, in Watt jnr's handwriting, includes calculations for eight different size engines.

Example 1

4 Horse

18 Nov^{r} 1800

Bryson & son		267
add Cisterns for feed App^{s} } & hot water }		2
Additional price of Boiler } 2/- p^{r} Cwt on 13 Cwt }		1 „ 6
		270 „ 6
25 p^{r} %		67 „ 11
	£	337 „ 17

But as a greater proportional profit should be laid on these small Engines to Compensate for the trouble of drawings &c it may stand in the Provisional Est^{s} at £ 350.

[B&W 7/VI/14]

At this time 4 Horse engines were not very common and it was felt that a small engine may create extra cost in its design and assembly.

Example 2

14 Horse

1800

20 Aug	Rigby & Chadwick		500 . 4. 4	
	Deduct for Crank Fly Wheels } £30 }			
	do Extra size of B^{r} 10 }		40	
				£460. 4
10 Dec^{r}	Huddart & Co		489. 16	
	Deduct for Crank & fly wheels	30		
	Do for stop pipe	5. 5	35. 5	
				£454. 11

1801

21 Jan^{y}	Hibbert & Smethurst		486. 4	
	deduct for Dbl Crank Motion 21			
	Stop pipe & bonnet	5. 4	25. 4	
				461
				3 |1375. 15
				458. 11
	Add for Cisterns			2
	Add^{l} for Boiler 33^{cwt} at 2/-			3. 6
				463. 17
	25 p^{r} %			114. 19
				£578. 16

Call it £600 as before

[B&W 7/VI/14]

The second example shows the calculation of a base cost for these three engines by the removal from the calculation of those parts that make them different and then finding an average cost plus the cost of additional items and then a mark up. The costs for each individual engine manufactured were recorded in the Engine Books and as an example of the origin of the costs used in the price calculations the Engine Book for February 1800 - February 1802 [B&W 232] lists the costs (summary) for the Rigby & Chadwick engine mentioned above as:

	Cwt	Qrs	Lbs	£	S	D
Cast Iron	192	2	5	210	17	1½
Wrought Iron	16	1	11	73	7	11
Copper Brass &c	4	2	4	53	2	1
Boiler	35		25	73	19	4½
Stores				5	8	6
Patterns				19	7	
Carriage				4	17	
Fitting				59	5	4
				500	4	4

The price calculations, and there are many still in existence, all show the same attention to detail with succeeding price calculations being based on the average cost of previous engines of the same size.

As time went by, the products the firm offered became more standardised, but reference to past cost was continually made in the calculation of the price of engines. The mark up eventually declined to 25% and then to 20% with no extra premium for London.

As successful businessmen, the partners were concerned to ensure that costs were covered and a profit ensued. Watt jnr monitored costs and prices to ensure that this continued to be the case. For example, a document entitled "List of Engine Materials and Premiums from 30th Septr 1798 to Do 1799" [B&W MII/7/2] compares the price with the cost of all the engines built by both the Foundry and the Manufactory during that period. Differences between the profit and the computed profit based on a percentage applied to cost were calculated and in the majority of cases the actual profit was greater than the expected profit, in some cases considerably more so.

In price calculation no reference seems to have been made to the competition, with all calculations being based on previous cost. Boulton & Watt engines were in a unique situation, having been the first to use a condenser, leading to greater efficiency and cost saving. Because of this uniqueness, the firm traded on its reputation for quality but pursued with equal vigour those firms that pirated their designs and tried to undercut their prices. However, the impending ending of their patent in 1800 and the

subsequent expected expansion in competition forced their attention on the pricing structure.

Price calculations were not limited to the price of whole engines, a comprehensive list of prices for individual spare parts was built up. Generally these prices were based on the standard rates for making that part plus a mark-up of 20 - 25% [B&W 7/IV]. In order to calculate new prices reference was continually made to the cost of parts made previously. The comprehensiveness of this process is illustrated in a document relating to the calculation of the cost of a cast iron beam rather than a wooden beam for a 40 horse engine in 1802. There appears to have been an inquiry as to the extra cost, a cast iron beam having technical advantages over a wooden one.

Beam Extra Materials A & G Murray		March 1802	
Cast Iron Beam	56.1.16	20/-	56. 7. 10
Turning & fitting Do		9. 12	
Part expence of pattern			6. 12. 6
2 Wro^{t} Iron Cutters for Caps	1. 4. 2½		
16 Steel wedges	11. 1		1. 15. 3½
Blacking & weighing		1	
		£	75. 7. 7½

Calculation of the difference between a Cast Iron Beam & a Wooden Beam for a 40 Horse

Materials of Cast Iron Beam as above			75. 7. 7½
Main Gudgeon	5. 1. 21		
Outer end Do	1. 3. 22		
Inner end Do	1. 3. 24	cwt	
Caps for Do	1. 2. 16 say 11 at 20/- 11		
Boring & Turning Gudgeons & Caps			6. 6
Do Main Gudgeon			17. 6
Part Expence of patterns			1. 3. 6
		£	94. 14. 7½

The following are from Mess^{rs} Wormauld & C^{os}

Wooden Beam - charged at the present prices - 1802

	cwt		
Main Gudgeon	4. 0. 10		
Saddle plate & Glands for int^{r} extd	1. 3.		
Gland for Centre of Beam	3. 0. 1		
Sad & Plate & Glands for outer end	1. 1. 6		
	10. 0. 17	@ 20/-	10. 3. 0
7 Pins & Nuts inner and back end saddle plates	151 at 7^{d}		4. 8. 1
2 Beam Straps Nuts &c	205 at 7^{d}		5. 19. 7
Wrought Iron Gland for back end of motion	22 at 7		. 12. 10
end of beam	176 at 7^{d}		5. 2. 8
Turned pin for outer end saddle plate	47		2. 7. 0
Turning Centre Gudgeon			12. 6
Patterns			1. 1
Weighing blacking &			10.
			30. 16. 8
Difference of Cost		£	63. 17. 11½
			15. 3
			79. 0.

[B&W 7/IV/60]

Note that the difference in cost includes the mark up of 25% rounded down to achieve an even value, a common practice; this customer would then have been asked to pay an extra £79 to have a cast iron beam fitted instead of a wooden one. Also, there was no allowance for timber in the calculation of the price of the wooden beam because it was usual for the customer to supply this.

The document continues with the calculation of other parts based on "extracts from the printed Daybook...". The costs of past work were used in many calculations and estimates relating to future work and the record of past costs formed an important data base to be used in the calculation of all prices.

Conclusion

The Soho Foundry was a new venture, designed from its inception to build steam engines, consequently the factory was built to ensure smooth and efficient working, a great achievement when it is considered there were no examples to use as a model. The factory that was built and staffed with dedicated, highly skilled and innovative people operated for many years. The Soho Foundry was designed to operate in the same way as its products. As a steam engine was designed to produce power, so too was the factory designed to produce steam engines smoothly and efficiently. As steam engines were designed to be self-governing so too the factory, accounting providing an essential part of this governance.

The accounting system was set up to reflect the organisation of production. It was designed around profit centres and recorded the flow of materials and work from one department to another. Because the Soho Foundry was a pioneering venture it is important not to judge workable solutions found to the problems that arose in the light of present knowledge and practice because of the differing contexts. The accounting processes extant at the Soho Foundry in its early years continued for many years so it is reasonable to assume that they supplied the perceived needs of that time. Certainly the number of documents showing calculations still in existence indicates that the accounting system provided a data base that was used by Watt in the managerial process, yet it does not appear to have been used to produce budgets or other forecasts.

Cost accumulation was an important activity, and was a basis for further activity. Costs were used as a basis for prices and as a check on profitability. Prior costs were

referred to when preparing quotations for the supply of engines, and they were referred to when working out prices for non standard engines or parts. The accumulated facts of the past then became a basis for the actions of the future.

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