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SETTING UP AN INDUSTRIAL ACCOUNTING SYSTEM AT SAINT-GOBAIN (1820 - 1880)

Abstract: In 1820, the *Manufacture Royale des Glaces*, founded in 1665 and also named *Compagnie de Saint-Gobain*, opted for double entry bookkeeping and cost accounting. At that time, both economic (industrial revolution) and juridical (abolition of the privileges and emergence of competition) events explain that change of accounting methods. From 1820 to 1880, the accounting system was progressively improved; most of today's cost accounting problems were discussed by the Board of Directors and in 1880 the accounting system was already very similar to today's full cost method.

Industrial Accounting: a New Information System. Modern accounting was popularized in 1494 when Luca Pacioli published *The Summa*; it was such an outstanding work that most French accounting historians suppose there has been no prominent theoretical discovery since that time. For J. H. Vlaemminck [1956], every improvement since Pacioli's time was only a minor amendment to the master's work. The emergence of cost accounting was never considered as a significant breakthrough in accounting technique.

The industrial revolution brought new accounting systems. These systems have been studied [Johnson, 1972; McKendrick, 1970; Stevelinck, 1976; Stone, 1973; Jones, 1985; Fleischman & Parker, 1990; and Porter, 1980] as well as the text books [Edwards, 1937] of that period. French authors such as Payen, [1817], de Cazaux, [1824], and Godard, [1827] were among the first to propound that accounting systems integrate the factory accounts into the old double entry bookkeeping system. This was quite surpris-

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ing if one remembers that the Industrial Revolution started in France a few decades after England. But several authors [Levy-Leboyer, 1968; Asselain, 1984; and Keyder & O'Brien, 1978] explain that the French economy always kept up with technological progress in Great-Britain. A massive deceleration in the economy occurred between 1790 and 1810; the French industrial production, which was probably equivalent in volume to the English one in 1790, was reduced to a much lower level in 1810. However, a new start occurred after 1810 and the two countries had parallel industrial growths all through the 19th century.

Cost accounting systems may have appeared around the turn of and after the 15th century in Europe [Garner, 1954]. They actually spread to most firms during the industrial revolution in the 19th century; first in England, then in France, then in the USA, and in Germany.

The aim of the present article is to describe the creation and development of such an industrial accounting system at Cie Saint-Gobain. This paper discusses the development of accounting by this very old company (created in 1665) between 1820, when it abandoned single entry bookkeeping, and 1880, when it achieved a full cost system. When examining the archives, this researcher saw no evidence that the textbooks mentioned above were read by anyone at Saint-Gobain.

HISTORICAL BACKGROUND OF SAINT-GOBAIN: THE ROYAL MANUFACTURE AND THE PRIVILEGE

Instead of continuing to buy glass from Venice, which was too much for the finances of the French kingdom, Colbert encouraged the foundation of a *Manufacture Royale des Glaces*, established in Rue Reuilly in Paris. The creation and development of the Company resulted from privileges granted by the monarch to businessmen successively in 1665, 1683, 1688, 1695, 1702, 1757 and 1785. Those privileges made the

firm a hybrid one, depending both on public and private laws; on the one hand it had a privilege and on the other hand the legal statutes of a limited Company [Pris, 1973, p. 26].

Having a privilege meant industrial, commercial, fiscal, administrative, juridical and financial advantages such as exemption of taxes, free circulation for goods bought and sold, and a prohibition for anyone to sell the same kind of product. Saint-Gobain was therefore protected from possible rivals and all those years of

privilege were turned to good account; the company gathered strength to face competition which was a real concern from 1810 onwards.

The first competitor appeared in 1770 in England, but the glass that this competitor turned out was not of such quality as to be a threat to Saint-Gobain. Further, the company's products were protected in France and potential competitors were punished by law until the abolition of privileges in 1790. The first legal French competitor appeared in 1804;¹ and the second one in 1823.²

THE NEED FOR A NEW INFORMATION SYSTEM

The Accounting System Under the Old Regime

In order to understand, analyze and assess the early accounting system, it must be remembered that relatively few of the company records have survived compared with the innumerable documents that must have been created over a period of 155 years. Pris [1973, pp. 290-8 & 856-64] faithfully described the accounting system under the old regime in his Ph.D. thesis, at the end of which he includes copies of most of the documents that have survived.

The company was nearly in a position of monopoly with regards to the production of glass. The customers belonged to the King's court or were local or foreign noble families. Therefore the accumulation of capital was not an essential aim and the market did not seem to be expandable. These are a few elements which give insights about the quality and relevance of the information system required by such a firm.

Very little is known about what the accounting system looked like before 1702; the statutes were only concerned with the accounting documents necessary to ascertain the dividends payable quarterly. They included "Inventory" or "balance sheet of bills and payments" (statutes of 1667, 6th item), or "statement of receipts and payments" (statutes of 1695, 18th and 20th items). An annual inventory had existed since the beginning of the company, but only those after 1774 have been preserved. The annual inventories were calculated in Paris by putting together all the inventories of every establishment of the company. The accountants do not seem to have worried about lacking consistent accounting methods; for example, land and buildings, tools and raw materials, finished

¹The Company of Saint-Quirin, with which Saint-Gobain finally merged in 1858, almost thirty years after the first discussions.

²Company of Commentry.

goods and cash are shown sometimes together, sometimes separately.

This inventory may be compared to the assets of modern balance sheets. It was accompanied by a cash statement. There were no liabilities since long-term debts had been forbidden by the statutes since 1702. The Company relied only on the funds contributed by its partners or on profits. After 1785, short-term debts were separated from each corresponding item of receipts. It was not until 1820 when the use of double entry bookkeeping showed liabilities as they are shown at the present time. Those liabilities included short-term debts and estimated liabilities so that the net worth (called "capital net") could be calculated. Inventory was never compared to the receipts and payments statement as a means of verifying the inventory. For example, depreciation was calculated at the end of the 18th century in order to have an accurate inventory, but it was never featured clearly in the calculation of profit.

The 18th item of the statutes of Plastrier's Company³ mentions that profit is the difference between receipts and payments, and that "they were quarterly calculated after the constitution of a 15000£ (*livres tournois*) reserve." This was the only means the Company had of knowing how much could be paid to the owners.

Such a simplified system was entirely in line with the desire to keep this information confidential. According to Sellon, an important Genevese shareholder of the Company, the simplified accounting system allowed any director, ignorant of accounting, to hold the Ledger *sans confidens*, that is without the help of a qualified accountant, so that secrets of the business could be preserved.

The term "capital" was not used. The statutes only say *fonds* or *effets*, which correspond to the inventory value of all the assets of the Company at a fixed date.

The owners' contributions to capital were made either in-kind (Venetian glass from Pocquelin in 1667) or in cash after 1702. They were considered an advance to the company, rewarded at a 10% rate. However, these advances were never refunded so that they can be considered as capital. The number of partners was fewer than ten before 1695. After that date, through inheritances and the selling of ownership interests, the number of part-

³The privilege was granted to businessmen; in 1695, Plastrier obtained the royal privilege and the firm could be called either "Plastrier's Company" or "The Royal Glass Factory."

ners increased (about 50 in 1770 and 204 in 1830). Unlike most firms of that period, it was not a family business.

The Turning Period (1791-1820)

The accounting system used in the 18th century achieved two main tasks: it computed the wealth (inventory) and enrichment (receipts and payments) of the partners, and it kept the internal movements of goods and cash under control with a comprehensive system of vouchers.

However, there does not seem to be any reckoning of costs before 1820. The Company waited for over 150 years before calculating a cost amount for its products. If one wants to prove the importance of that turning point, the quotes below from two managers are evidence. In 1793, i.e. during the French Revolution, the Company delivered to each associate an "Instruction to help the interested parties in the Manufacture of glass with the declaration form they had to fill in about their interest in that trade, according to the Compulsory Loan Act of the 24th of August." Such a document⁴ had four aims, the most important of which was providing knowledge of the profit of the year 1793. According to the order-in-council, "the benefit was that which went beyond the interests of the funds invested." The interest was easily known (5% of the net worth) thanks to the inventory. But as regards the evaluation of benefits, the calculation seemed quite impossible from the authors' instruction:

Things do not go with glass as they do with cloth, for which the cost is known even before we put it on the frame. Glass, on the contrary, never preserves its original value. The flaws entail scraps, that is why the benefit of the glass production is a random result and it is impossible to calculate it.

In 1829, the Baron Roederer, a director of the Company of Saint-Quirin, expressed quite an opposite point of view when he described the problems raised by the possible merger of the two competing companies.⁵

It seems that in this case, everything could be reduced on both sides to the calculation of a square foot of glass.

⁴Marked C6-2 in the archives of the Company

⁵Marked AA17 - file 2. "Procès-verbal historique de la session de la Compagnie de Saint-Quirin. 1^o Juin/13 Juillet 1829"

Everything is included in such a calculation, everything can be summed up to that result; we find in it the effects of the chemical, mechanical, physical process, the advantages of activity and workforce discipline, and finally the effect of every resource, of all sorts of economic means, particularly that of a lower capital producing as much or more. The evaluation of each Company, that is to say its contribution to the association, will result from that cost, or return, combined with the number of squarefoot produced, and with the effective selling price, including of course the quality or the degree of perfection of products.

What happened meanwhile in the economic field? Which factors were strong enough to lead to such a systematic calculation? The conditions of production had slightly evolved in that period, but the main change came from outside the firm. Between 1793 and 1829, the dates of the two preceding quotations, the Company's Privilege disappeared and something new emerged: competition.

The upheavals resulting from the Industrial Revolution seemed to have led to the widespread acceptance of cost calculations as the only efficient means to compare the activities of competing firms. This is particularly true for firms that did not have any competition before 1790. Moreover, one can observe that industrial accounting and cost accounting books appeared in France from 1817 onwards, and can find several authors of that period saying: "I am the very first to find a new approach to the problem."⁶

THE SETTING UP OF THE NEW ACCOUNTING SYSTEM (1820-1834)

The proceedings of the Board of Director's meetings have been preserved; from these it is apparent that a new accounting system began in 1820. However, the actual accounting records from before 1825 have not survived. From the 1825 accounting records, it is clear that there is a new system of reporting which was long in being developed; a Profit and Loss Account was pre-

⁶A. Payen, in the *'preface'* of his book [1817, p. 2] says "I was told to write (such a book) because books dealing with factory bookkeeping did not exist". L. Mézierès, in the *'avertissement'* of his book [1842, p. iii et iv] says: 'we do not know any book in which commercial, industrial and factory accounting are dealt together'. L.F.G. de Cazaux [1824] and E. Degranges fils [1842] both say that they wrote their books at industrialists' request, because of the lack of reliable accounting systems adapted to their field of activity.

sented every year and a set of accounts was finally approved by the Board of Directors in October 1832.

From these accounts came a steady stream of information in the form of reports from the chief accountant to the Board of Directors, including sets of unitary costs at every stage of the manufacturing process. Moreover, the directors frequently visited the branches of the Company.⁷ Those three elements combined to create a real Decision Support System.

The Manufacturing Process. Before going into the accounting problems, it is worthwhile to describe briefly the operating process for glass. Glass production can best be described as follows:

from several raw materials (silica, soda and lime) they produced glass by pouring and flattening it in order to give it its plane shape; the glass was then annealed in order to improve its mechanical qualities. After that “hot process”, the “cold process” began, to rectify or get rid of the shortcomings of the flattening; it was divided into two stages: abrasion, called “*douci*”, gave the two faces their parallelism and general flatness; then polishing, called “*poli*”, to improve the quality of the surface; after abrasion, the sheet of glass was translucent but not transparent, because it was still slightly grained, and it only turned perfectly transparent at the end of the polishing [Daviet, 1988].

In accounting for the production of glass, the company made a distinction between the costs of pouring, abrasion and polishing. Charges were not classified according to their nature, but to their place in the manufacturing process. During the 18th Century, the Company had four branches: its Headquarters in Paris, a mirror factory in Saint-Gobain (Aisne), another in Chauny (Aisne), and a soda factory in Chauny. The first document available is a Profit and Loss Account (*Compte de revient*) dated from June 30, 1826.⁸ This Profit and Loss Account was organized according to the inventory production and corresponds to the period beginning July 1, 1825 and ending June 30, 1826. Details of this account are shown in Table 1.

⁷There were three branches in the north of France; one of them, the first, was settled at a small village named Saint-Gobain.

⁸Marked AA42-6, page. 6.

Table 1
Profit and Loss Account for Year Ending June 30, 1826

We have sold 257 000 square foot for	F	2 619 802
the benefit was only	F	407 402
less some expenses, written on the		
profit & loss account	F -	68 365
Manufacturing benefit on glass	F =	339 036
Interest of loans	F +	85 000
Profit on timber	F +	76 000
Various profits on chemical produces,		
glass-silvering, etc.	F +	143 430
Total profit of the year	F =	643 466

In all likelihood, the 68,365 F are overhead costs of the Paris office (interests, wages, operating expenses; including, perhaps depreciation). The interest revenue is quite important to the 1825-1826 year's operations. Thanks to a very prudent financial policy, the benefits of the preceding century had been used for hoarding up a treasure invested in debt securities and loans (notes receivable).

In the early period of the Company, Saint-Gobain produced soda and various chemical products in Chauny; the aim was an independent supply of raw materials. The exploitation of timber worked towards the same end for self-sufficient supply of fuel. The profits earned from those ancillary activities were 65% of the profits earned from glass.

For the financial year 1827-1828, the *Copy of the report from the chief accountant to the administration* has survived. Particularly noteworthy is the use of a commercial year, from July 1, 1827 to June 30, 1828, rather than reporting on a calendar year or a year ending on a particular day of the week. The Profit and Loss Account is clearly and definitely separate from the inventory. This report includes ten items:

- 1) The account for manufacturing raw soda
- 2) The account of the salt works for manufacturing soda salt
- 3) The account for the use and sale of the soda salt
- 4) The account for manufacturing the muriatic acid
- 5) The account for timber
- 6) The account for manufacturing and selling glass
- 7) The comparative chart for the costs of abrasion and polishing for all the branches and the chart for loss and waste in the mirror factories.
- 8) The account for tin sheets
- 9) The profit and loss account
- 10) The trial balance

This report represents a typical example of process costing. The following remarks are indicative of the complexity of this accounting system. For each element, the manufacturing cost per unit is determined and the variations compared to the preceding financial year. The components of each cost per unit are subtly analyzed. For example, the item concerning raw soda is analyzed in the company report as follows:

Raw soda cost in 1827	9F50 for 100 d.
it cost in 1828	9F00 for 100 d.
that is an improvement of	0F50

- due to 1) a difference in the price of sulfur
- 2) a difference in the price of salt
- 3) a difference in the price of coal
- 4) a decrease of the costs of maintenance and repair

Those advantages are in fact slightly reduced by increases in other expenses, but we produced this year 448 000 d more than the preceding year, consequently the overhead costs for salaries and interests contribute to the cost per unit in a smaller proportion.

The Accounting Process. From the account for manufacturing glass, it is apparent the way that the costs of production were determined for the period. Each branch was involved in the production of only one product, so that costs were first calculated for each branch. The manufacturing cost included all the expenses for raw material, wages, expenses for maintenance and repair, and all the investments concerning the branch, including the construction of buildings. The manufacturing cost determined the “price” at which the branches sold their production to the Headquarters in Paris, which was the only division of the company that could sell to customers. In Paris, a new cost price was calculated including the operating cost, depreciation, and dividends. For example, the cost of abrasion and polishing was said to include three essential elements:

Expenses	58 454
Wear	21 802
Interests	<u>18 002</u>
TOTAL	98 260

“Wear” means depreciation of buildings and machinery, and “interests” are the profit distributions paid to the partners. Since (1) the statutes of 1702 forbade long-term debts and (2) the part-

ners were asked for contribution every time there was a need for cash, then "interests" paid to partners on their capital balances are comparable to today's interest expense.

The Profit and Loss Account first recorded the gross profit of production. Then came the application of overhead costs of Paris and some unusual expenses, such as bad debts or differences in the calculation of costs due to fictitious expenses. It includes also an equivalent of the modern French "Appropriation Accounts," showing the profit distributions paid to partners.

The Financial Statement of June 30, 1828 shows, on the one hand, the current assets (cash, checks to be cashed, investment loans and receivables) and, on the other hand, the short-term debts (to partners, to suppliers, to various debtors, to the branches of the Company). The difference (working capital) is a respectable amount, due to the prudent financial policy:

Current assets (<i>Actif realisable et disponible</i>)	2 875 000
Short-term debts (<i>Passif exigible</i>)	<u>237 200</u>
Net current assets (<i>Net de l'actif financier</i>)	2 637 800

In 1820 when choosing an information system adapted to the requirements of a modern industrial firm, the Manufacture of Glass developed a set of accounts which ultimately were approved for the Company by a vote of the Board of Directors on October 30, 1832. Meanwhile, in 1830, the Company had become a Limited Company with new statutes. According to the historians of the Company, that date marks the irreversible passage of the firm into the industrial era.

This new set of accounts required that the warehouse keepers had to maintain the accounts for raw materials and finished goods, while the branches' cashiers, in addition to maintaining manufacturing accounts and assets accounts, kept a cash book in which expenses (wages and others) and receipts (payments from the Paris Headquarters for the finished goods) were carefully recorded. The Directors of every branch also were required to send an inventory which listed buildings and machinery to Paris. Then, the central accounting office saw to it that the calculation of depreciation was done.

THE NEW INFORMATION SYSTEM COMES TO MATURITY

The new double entry accounting system allowed the calculation of cost amounts. However, bringing to light new information gives rise to new questions about the quality and relevance of this

information. How do produced quantities influence the costs per unit? How can costs, calculated at different times, be compared? What is the best way to distribute the overheads? etc. . . .

After the setting up of the accounting system, a long process of maturation began. This is evident, on the one hand, from the discussions of the Board of Directors and, on the other hand from the differences between the two sets of accounts approved by the Board of Directors in 1832 and 1872. The structure of the Company evolved considerably between 1832 and 1880: two mergers occurred, the first one in 1858 with Saint-Quirin, a glass manufacturer, and the second one in 1872 with Perret-Olivier, whose fields of activity were mining and chemistry. After the second merger, the sales figures for chemistry outstripped the sales of glass and mirrors and during this time the Company had grown to include 16 branches in France and Germany.

DISCUSSIONS ON INDUSTRIAL ACCOUNTING

All the questions dealing with the setting up of a management accounting system were discussed by the Boards of Directors. In most cases, the solutions were only practical ones. There never seemed any intent or desire by the Company to make any theory or any generalization of those practical solutions.

Direct and indirect costs. The distinction between direct and indirect cost was made first in 1829 with regards to labor charges.⁹

Salaries, of which a comprehensive list is given above, will be separated into two groups:

- 1) Those concerning directly and specially with the manufacturing process.
- 2) Those concerning administration.

At the end of the year, the former will be divided and included in the suitable items of expenses; then the latter will be included in the overheads.

However, direct labor is likely to have included only the wages of workers having a permanent job, and excluded those of the day laborer, which are by their very nature fluctuating. In the soda factory, the majority of workers were day laborers, thus making it difficult to estimate precisely the ratio between direct and indirect labor charges.

Production level and cost per unit. In the previously quoted chief accountant's report concerning the financial year 1827-1828,

⁹Document marked AA 42-5.

there are remarks about the cost per unit of raw soda. The directors were well aware that production level and cost per unit were in inverse ratio:

... this year we produced 448 000 d: more than the preceding year; therefore, the overheads for salaries and interests contribute to the cost per unit proportionately less.

Allocation of overhead. The allocation of overhead costs was discussed during four meetings of the Board of Directors: March 7 and 13, 1832; August 20, 1833; September 4, 1834.¹⁰ The members of the Board discussed the allocation of overheads between glass and chemical products. At the first meeting, on March 7, 1832, it was reported:

The Administration (of the Company) has decided that the overheads accounts of every branch will be divided in accordance with the production as shown on the books; each product (*produits speciaux*) will be charged with its own direct expenses (*frais speciaux*).

At the meeting the next week (March 13, 1832), the record indicates that overhead cost allocation was again discussed:

It has been pointed out to the Board of Directors by one of the members that the preceding decree, dividing overhead expenses in accordance with each factory's production stated by its books, could entail serious drawbacks; for example, in a year of very low sales, if we stop the production and only sell glass in stock, we should be obliged to make the chemical products bear all the overhead expenses, which means a considerable increase in their cost prices and gives us a wrong image of them. He (the member of the B. of D.) thinks it much more convenient to divide the overhead expenses in accordance with the fixed capital involved in each one of the two factories, as shown by the general inventory, capital to which we add the required working capital; with such a manner of distribution, each factory would bear its own part of overheads required by the supervision and administration of its capital. In the above-mentioned case of a factory's producing next to nothing, we would have to state a loss for that factory, which is quite normal.

¹⁰Document marked 4B5, p 140.

After a long discussion on the advantages and drawbacks of each method (production or capital), it was decided that the decision would be made during the next meeting. On March 16, 1832, the Board opted for the capital method. However, the debate was revived less than a year later when at the August 20, 1833 meeting the chief accountant was instructed to compare Saint-Gobain's and Chauny's respective efficiencies.

... we shall probably be told, with good reason, that if cost prices are charged with the mostly arbitrary distribution of overheads, those cost prices are an unreliable means of comparing the economical efficiency of different methods of manufacturing. That is why we wish to propose a third way in which overhead expenses of the Headquarters are not charged to any production. For the last four months, Saint-Gobain has been costed at OF79 per square foot. At Chauny, both raw materials and labor are worked out at OF51 per square foot. If you add the depreciation of the building and the machinery of that factory, the cost rises to OF71, and if we wish to have figures that could be compared to those of Saint-Gobain, repair expenses for the machinery, the cost for slack periods or flawed glass must be added. The records in our accounts are not yet accurate enough and moreover too recent to allow us to give precise figures for these kinds of expenses. But no doubt they will go over OF80; consequently, the question of economical efficiency is settled.

The overhead expenses to be shared included traveling expenses, tokens, salaries of administrators, a hypothetical rent for the Paris building, and operating expenses, but the fate of dividends paid to shareholders was not sealed. It was raised on September 4, 1834 by the chief accountant:

It has often been said that we should not include dividends in the cost prices: this is a big mistake; a Limited Company must always be considered as a business which, thanks to its repute, can borrow funds for its activity: those funds produce interests, which amount must be deducted from the profit ... if the interests were not included in the cost prices, we could not know the real profit of the soda factory.

The Continuity of accounting methods. The Board of Directors of Saint-Gobain was also concerned about comparability of accounting data over periods of time and under different variation methods. The following quotation may seem somewhat difficult to

understand without complete information on the way stocks of materials were valued. It shows, however, the desire to obtain inventory data that could be compared even if valuation methods had changed.

The account for timber shows that the Saint-Gobain's factory consumed this year up to F 353 736 worth. However, the figure in the glass manufacturing account is F 466 388. This is why: the administration of the Company took steps to make the price of timber much lower than it had been in the preceding years; so, it would not have been appropriate to give those existing on June 30, 1828 the value they would have had without that decrease. We estimated them in accordance with the proposed current rates, and the difference in prices makes a difference in the accounts of up to F 112 631; it means that the existing timber in the inventory have been estimated at F 112 631 less than their actual cost and the expense must therefore be increased by the same amount. That fictitious increase on fuel expense has an appreciable influence on the manufacturing cost of glass.

How to motivate employees to be efficient. In 1820, both a new accounting system and a new system of remuneration according to merit were set up. There does not seem to be any clear link between the two events, but the fact is: they were concomitant. From a note, written after 1830,¹¹ motivating employees was discussed:

In 1820 the former regular bonuses given every year to every employee were abolished; those bonuses were considered as a part of the wages. After that date, the administration decided to grant bonuses from time to time, as a reward of the ability and efficiency of some employees; the administrators thought it was more convenient to keep those bonuses secret, in order not to cause envy and demands from the employees who did not receive bonuses. From that time, it was decided to create a special cashbook .. supplied by special accounts said to be known only to the administrators.

The 1820 system seems to be only a roughcast, the expression of a desire. It was not until 1833 that a scientifically created system of remuneration was actually implemented,¹² which meant

¹¹Marked 1H4. Document N 2.

¹²Information on the rewarding system can be found in the document marked 4B6.

that the expected results of such a system determined the amount of bonuses. In June 1833, the Board of Directors approved the incentive plan which had already been started the previous February. The criteria governing the allocation of bonuses were discussed before the final plan was adopted. The Board of Directors first rejected a system that based the bonuses only on the amount of scrap produced. The Board found this criterion too quantitative and added a second criterion which assessed the quality of glass produced. In January 1834, a first evaluation was presented to the Board of Directors, according to which, the system "succeeded in lowering cost prices." Along with the decrease of cost amounts, the plan aimed at "ensuring the commitment of the workers and the lower supervisory staff to a good quality of glass." According to Daviet

the bonus system, created by Clement DESORMES in the soda factory, eventually introduced in the wage a variable part of 20 to 30% of the total, which is rather a large amount, and explains the workers' distrust at the beginning.

The system was then extended to the glass factory of Saint-Gobain. From this, it can be concluded that the institution of a new system of remuneration which had been started in 1820 came to fruition in 1834. This occurred at the same time that a cost accounting system was developed. This adds weight to the thesis of a causal link between the emergence of competition and the calculation of costs. In fact, the aim of the new system of remuneration was clearly linked to the desire to reduce costs.

Accounting for Depreciation. As previously pointed out, depreciation had long been calculated. In the 18th century, such a calculation was only used to estimate the actual value of buildings and machinery and draw up the inventory. In his report to the Board of Directors meeting on September 4, 1834 the chief accountant writes:

COST PRICES OF OUR PRODUCTS. A decision of the administration determined the way depreciation of buildings and machinery would be settled: buildings bear a yearly depreciation of 1/20 and machinery 1/15. When that decision was taken, the consumption of sulfur and the decomposition of sea salt were in a very usual proportion; but now the soda factory has almost doubled its production; so, do you think, dear Sirs, that we must maintain that depreciation rate? I am all the more con-

vinced that we should not, because I am certain that the lead chambers, considering of the huge quantity of sulfur burned inside, won't last more than 6 years instead of 15, as formerly forecasted. If that fact is confirmed, depreciation is not important enough and the profit of the soda factory is overvalued.

Though the Board of Directors at the September 4, 1834 meeting was not asked for a decision as regards the length of time allowed for depreciation, it was asked to decide whether depreciation should be taken on machinery during the first year's service. In the same report, the chief accountant maintains the fictitious nature of the depreciation taken into account:

... let me remind you of what I told you in my preceding report: there is only one means to have an exact idea of depreciation: it consists, when a building or a piece of machinery is out of use, in appraising its value, and when it is destroyed to take into the Profit and Loss Account the remaining value, less the selling price of materials. By that means we could know exactly the depreciation life of a building or a piece of machinery ...

The method of calculating depreciation was to be completely reviewed in the 1870's as discussed in a subsequent section.

Transfer pricing among factories. Transfer pricing also became an issue which was considered by the Company in developing its cost accounting system. The issue arose because the soda factory sold its products to the glass factory on the one hand, and to external customers on the other hand. It first seemed correct to use the same price until this price appeared excessive due to approximate methods of valuing the quality of goods sold:

If that increase in the degrees (measure of quantity for soda) is of little importance for customers delivered to in Paris, it is quite different for the Saint-Gobain's branch which pays for more degrees than it really gets. Consequently, the soda factory makes a profit to the detriment of the glass factory and increases its cost prices.

To conclude, the chief accountant makes some proposals among which:

3) Wouldn't it be convenient to choose a uniform way of costing as regards the transfer transactions between our branches? We could use either the cost price or the market price.

The author did not discover how the transfer pricing issue was ultimately resolved.

THE 1872 BRANCH SET OF ACCOUNTS

The slow maturing process that started with the setting up of a cost accounting system in the 1820's and 1830's led, in 1872, to the adoption of branch accounting in which each branch of the Company had its own set of accounts. This development placed the Company very close to a modern day cost accounting system used by French companies today. All the basic principles were present in 1872.

The July 25, 1872 instruction does not attribute a number to each account and does not group accounts into "classes" as is now done in France. Therefore, the following classification is the researcher's and consists of five categories: the balance sheet accounts, expense accounts, activity center accounts, perpetual inventory accounts, and manufacturing accounts.

- 1 — Balance sheet accounts
 - a. "Central administration": looks like a current account of the Paris Headquarters by the branch.
 - b. "Industrial buildings, tools and machinery"
 - c. "Debts"
 - d. "Drafts on Paris"; to be paid by Paris
 - e. "Drafts on the factory"; to be paid by the factory
 - f. "Cash"
- 2 — Expenses accounts
 - a. "Supply"
 - b. "Wages"
 - c. "Sundries"
- 3 — Activity center accounts
 - a. "Transport"
 - b. "Varied workshops"
 - c. "Work of the machinery"
 - d. "Works of carriages and horses"
 - e. "Overheads"
 - f. "Maintenance of buildings"
- 4 — Perpetual inventory accounts
 - a. "Raw materials warehouses"
 - b. "General warehouse" for cleaning materials, etc. . . .
 - c. "Finished goods warehouse"
- 5 — Manufacturing accounts; one for each product

The activity center accounts were debited with all indirect charges (wages and sundries). They were credited with the sums apportioned to each type of production. As regards the "work of the machinery" account, the key for sharing the charges among all products is indicated: ". . . the sharing of expenses will be made up to the power consumed in each workshop." As regards "over-heads", they were shared "proportionally to the direct labor with which every manufacturing account was debited." Some of these accounts were credited with the products of subsidiary activities; for example, the "work of carriages and horses" account was to be credited. As a contra, a debit to the warehouse account was recorded for the "dung produced." Don't be wasteful!

THE IMPORTANCE OF DEPRECIATION

At Saint-Gobain, depreciation methods barely evolved between 1830 and 1872. From that date, the Directors paid new attention to the problem.¹³ There were essentially two reasons for this: on the one hand, the Directors recognized the necessity of investing more and more in machinery, and, on the other hand, they were bound to respect their "no long-term debts" policy. The Company had to preserve the sums of money that were essential for its growth, but it was quite impossible to say this bluntly to shareholders who were numerous and not well aware of management matters. Until then, the Company made a distinction between ordinary depreciation, "calculated according to steady rules", and extraordinary depreciation, "determined by the Board of Directors according to the profit and rectifying the slow progress of the ordinary depreciation as regards the value of some items". Further on, the record shows the directors' concern that "the only drawback of the system is its arbitrary aspect; the shareholders argue that to accuse the Board of Directors of deciding the dividend according to their desires and not to the year's profits."

At this time, there was no radical changes of the depreciation method. There is just evidence of greater scrutiny in valuing the assets, and more concern for keeping the shareholders acquainted with the management of the Company and the problems management faced. Nevertheless, as a result of that discussion, the Board of Directors had to deal with many problems linked to the efficiency of an accounting information system: precise methods for the valuation of fixed assets, definition of the quality and quantity

¹³This passage comes from a file concerning depreciation. It is marked 1H4 and includes documents dated from 1872, 1873, 1879 and 1880.

of the information given to the shareholders, precautions to take for upward appraisal of capital assets, choice of an investment, and dividend policy.

In order to raise enough capital for its business, the Company had to inform a growing number of shareholders, which soon became inconsistent with the managers' freedom to deal with accounting information according to their own needs. The resolution of this problem led to the distinction between standardized financial accounting for external and management accounting for internal use. As it became more and more efficient and advanced, the accounting system led to its own splitting.

CONCLUSION

Compared to most of the firms, Saint-Gobain had to face very early (in the first half of the 19th century) the problems raised by the setting up of a management accounting system. However, it was not until 1820, 155 years after its creation, that it adopted double entry bookkeeping which included the calculation of costs. This evolution is mainly due to the spreading of the Industrial Revolution in France, which was responsible for the abolition of privileges and the growth of competition in the field of glass production.

During the period 1820-1880, the cost accounting system had been gradually improved, without any regular outside coercion, according to the needs of the management alone. This leads to two conclusions and two research questions.

In 1880, the accounting system facilitated the reckoning of full costs with methods and procedures that are still in use (allocation of the overhead with the use of activity center accounts, up-to-date transfer pricing methods, analysis of the relationship between depreciation, dividends and investments, etc. . . .). This full cost method is now over one hundred years old. The development and the mastering of that cost accounting system were absolutely necessary to start the next stage, that is to say the use of those costs to prepare estimates of costs and investments. That stage took place over four decades (1890 to 1930) and led to real budget control towards the end of the Second World War.

It should be recognized that the accounting systems of a given period can be very different from one another, which is particularly true in the 19th century, therefore research should look at the variables on which the accounting system of each firm depends. Among the internal ones, the size of the firm, the culture of its

management, and its type of production seem important. Among the external ones, the legal environment, the level of technology used, the scarcity (or abundance) of capital, etc. . . . For future research in this area, there remains plenty of work on hand and the firms' archives have not divulged all of their secrets.

The double entry bookkeeping system has been established since the time (14th and 15th century) when it was indispensable to the merchants; the industrial cost accounting system became established at the same time as the Industrial Revolution, the beginning of the 19th century in France. The regulation of accounting standards developed gradually with the growing intervention of governments in the capital accumulation process (between the two World Wars). Future research should consider the relationship between the dominating capital accumulation procedures (commercial, industrial or social) and the dominating accounting systems of a period. Perhaps dominating capital accumulation procedures determine the way firms compete, which in turn determines their need for information, and therefore their accounting system.

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