Cost systems: *A renewed approach*

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Introduction au calcul de coûts, E-Thèque, 2002, http://numilog.com/ ebook

Gestion financière des organisations coopératives, co-auteur, Michel Belley, Gaetan Morin ed, Chicoutimi, 1985

Le calcul des coûts dans les organisations, collection Repères, La découverte, paris, 1995

Eléments fondamentaux de comptabilité, co-auteur Guy Rochery, Vuibert Paris, 1990

Outils de gestion, Ed Malesherbes, Paris 1989

Systèmes de coûts, Ordre des experts comptables et Dunod Paris, 2005

Cost System Design, Palgrave MacMillan, 2009

Systèmes de coûts : une approche unifiée, 2013, *https://www.**researchgate**.net*

Cost systems: a unified approach, 2014, *https://www.**researchgate**.net*

Les systems de coûts dans les organisations, 2017, La Découverte, collection Repères, Paris

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Introduction

Anything can become a cost object! Long confined to the industrial sector and its products, cost evaluation is common in the service sector today. Not only transaction related activities, but also anything that can be subject to a decision is a candidate for cost computing, whether inside an organization or outside, whether in the market field or in the not-for- profit sector. The concept of cost would be mobilized as soon as there is a need to assess the usage of resources. A cost is indeed the translation in a monetary form of the valuation of the consumption of resources necessary to obtain an object. This object was traditionally an industrial product subject to unit transactions on the market. Such objects still exist, but they have become unquestionably a minority. They are complemented by services, both private and public, and also by a new form of object: relationships between partners (the cost of a client), project, fraction of Organization (the workshop.X.), the assembly of fractions of different organizations (supply chain), investment, reorganization, etc. If it is a single, ad hoc assessment, one should deal with the information by ensuring its relevance to the object. If it is a recurring evaluation, information should be organized within a system, and it is the relevance of the system, as a whole, which requires analysis.

This book deals only with recurrent assessments and, consequently, with the design and use of cost systems. The concept of cost systems is relatively recent. Calculating cost was previously associated with a method and not a system. The methods have not disappeared, but if they have ceded their place in the vocabulary to the concept of systems, it is because we have recently become aware that beyond the actual method, the calculation of costs implemented multiple interrelated components and not only a sequence of rules. The first objective of this book is to show that the method of calculation, far from being at the base of the differentiation of the multiple cost systems available today, can be codified within a unified framework. This analysis confirms the interest of the use of the term of systems instead of the term method when one is interested in other dimensions than the simple computational exercise.

The choice made here, after presenting very generally the concept of cost system, is to focus on the calculating machine, i.e. on what traditionally constitutes the heart of education. In other sections we discuss the other dimensions of cost systems to understand their logic and to assess their potential relevance. The second objective of this book is to show how the technical substrate adapts to reflect the vision of organizational relationships and management philosophy of the organization.

However, as systems often have a long lifespan, one can also say that the system in place implicitly conveys a certain vision of organizational relationships without the actors always being aware of this. This is even truer for the relationship between the technical substrate and management philosophy, rarely made explicit. Here again, the reading of the relationship is two-fold. At the time of the design, it is possible to configure the cost system to gain consistency. Over time, it is the cost system which implicitly guides the choices of the organization by the selection of the signals it emits.

The book ends with a methodological proposal to facilitate assessment of the relevance of cost systems, by linking the three objectives of the cost system and its three dimensions previously mentioned.

The reader must already be warned of the gap that exists between the canonical version of cost systems, the version which is broadcast in the literature and taught, and the operational versions implemented by organizations who adopt them. Beyond the aliases, all organizations implement specific configurations which result from local adaptations of the conventions that organize each family of cost systems. Our ambition in this book is to facilitate decryption of these specific configurations and to highlight their strengths and their weaknesses.

1 / The two components of cost calculation

Whatever the cost system used, two representations are required: the representation of the organization and representation of the object to evaluate. The representation of the organization mobilizes two concepts: the unit of analysis and the internal resources. This is within the responsibility of management control. The representation of objects takes the form of a bill of operation and a bill of materials. It is generally under the jurisdiction of the methods service.

The cost of the objects is the result of the connection of these two representations which are developed below.

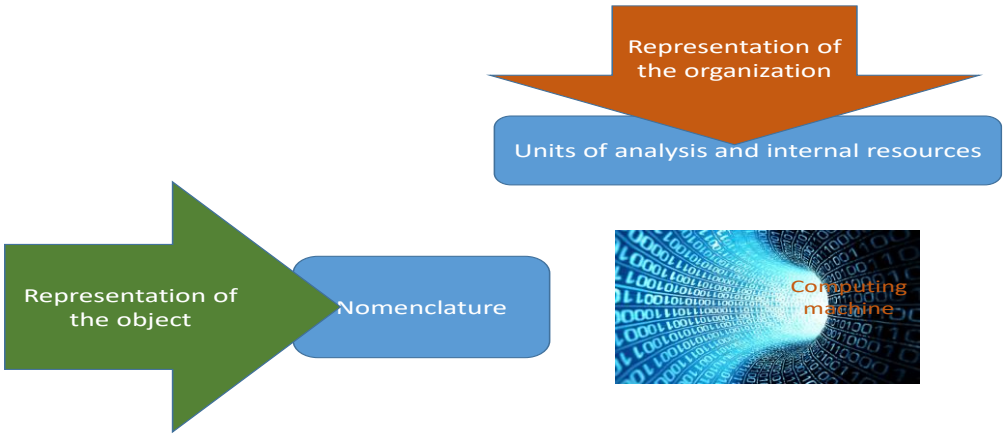

Figure 1: The calculation of costs

The organization and its representation

The ambition of cost calculation is to explain how the resources acquired from the environment are implemented within the organization to result in objects that are themselves for this same environment. Financial accounting captures incoming and outgoing flows but says nothing about the internal processes ensuring the conversion of resources into objects. To illuminate this conversion, it is necessary to go into detail of the different production processes to build a representation of the economic operations of the organization. Who says representation, says choice of angle of view, resolution, installation time, filters, etc. Each system is a representation, this will be reviewed in detail later. What matters here is to note that the organization which hosts a cost system is represented by units of analysis that depending on the cost systems, bear different names but always have to provide a representation of the organization.

These units of analysis consume a fraction of external resources (from another information system) combine them and deliver a service which in turn becomes a qualified internal resource (created in cost systems) to distinguish it from the first. In many systems, the units of analysis correspond to local production functions, and internal resources to their production.

These internal resources then combine (possibly) with external resources to create objects that are available for the environment.

Even if the representation that is used does not clearly identify production functions and their production, the units of analysis and internal resources must always be interpreted as such.

The object and its representation

The representation of the objects in the form of nomenclature and bills of operation dates back to the early days of standardization. The transition from the unitary production by a craftsman to mass production by poorly trained workers has been possible only by developing a detailed description of the physical components (bill of materials, BOM) and of the conversion operations (bill of operations, BOO), both describing the gradual transformation process of external resources into a final object. With the development of support services, and the diffusion of cost calculation in the services sector and industry, the distinction between BOM and BOO has become blurred and one talks of nomenclature (sometimes of extended nomenclature) to encompass all the elements and operations necessary to obtain an object.

For physical objects, this covers components, materials, and all the operations of the production process. For a delivery the nomenclature will, for example, include deliverables, handling operations, administrative follow-up and transport fees. For a client, one should find the purchased products, deliveries, but also visits to the commercial outlet or digital processing of orders, returns and possibly financial costs related to payment delays. These are examples to show the extreme diversity of the objects to evaluate and hence the difficulty in representing them. For example, our client has ordered from our stock, then its nomenclature will be limited to the ordered product, but if he has ordered a specific batch or an entire pallet, the nomenclature will change to account for these features. The information system does not always provide this kind of information. As noted for the representation of the organization, the representation of objects depends also on a point of view, the angle of view, resolution, installation time, any filters, etc.

At the end, the cost will result from the meeting of two conventional representations whose sources are multiple: theoretical *a priori*, informational constraints, usages of the sector or branch, historical, etc.

Figure 2

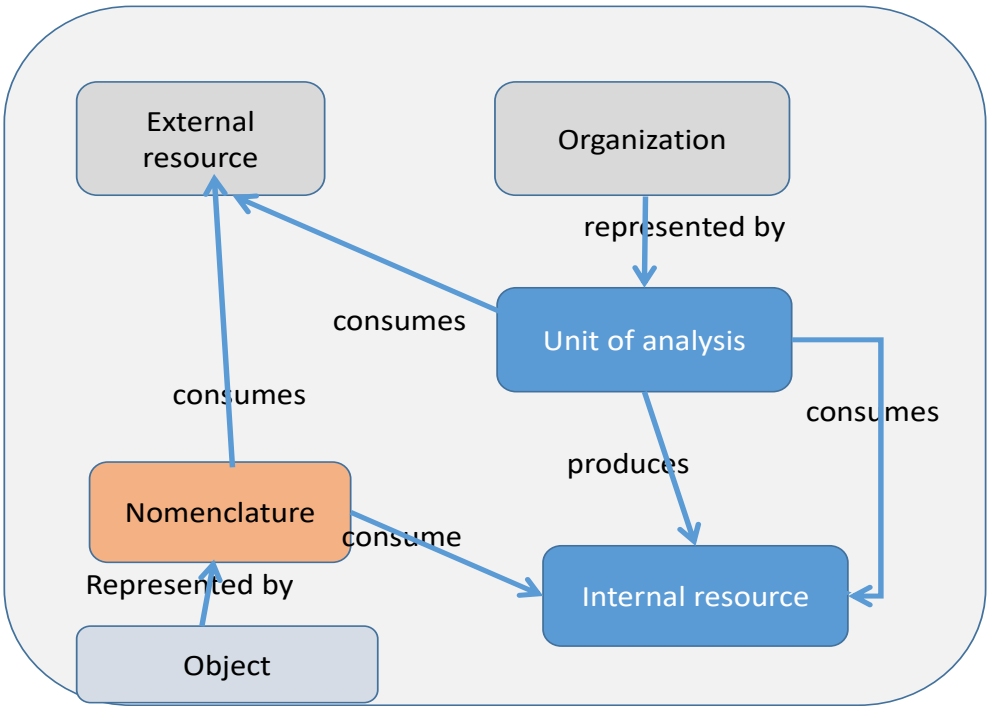

Figure 2: Structure of cost systems

Figure 2 summarizes the two preceding paragraphs and offers a simple decryption tool of all cost systems. Each of the concepts mobilized for the implementation of this diagram will be studied in detail later. What interests us here, cost calculation, this global vision is enough to realize that everything happens encompassing three components: the unit of analysis, their internal resources and the nomenclature representing the objects. A fourth element participates in the evaluation of the cost of the objects, the external resources directly consumed by the object. But whatever the cost system studied, these external resources are subject to a direct evaluation and are therefore independent of the cost system itself. This does not mean that there is only one way to assess external resources implemented in the objects, but that all the variants are available for all systems. They, therefore, do not constitute a differentiating factor.

The framework is now in place: we will discuss different calculation situations, both from the point of view of the objects as of the organizations, thereby enabling us to arrive at a universal calculating machine.

2 / The cost calculating machine

As indicated above, the calculation of costs results from the crossing over of the representation of the Organization and of the objects to evaluate. This can be done easily by organizing operations within a matrix. The organization of the matrix has no impact on the calculation, in this text we will always keep the same approach: external and internal resources (Organization) will find their place in the columns and the BOM lines will naturally be the rows of the matrix.

All resources must be identified by two pieces of information: their name and their unit value (cost or price)

All BOM lines are equally characterized by two pieces of information: the name of the resources required and the necessary volume of this resource for the unit of the evaluated object.

A third piece of information is required: the volume needed for the object to evaluate.

If unit consumption of the resource does not pose a problem of interpretation, it is directly derived from the nomenclature, and the reader should be warned about the multiple acceptance of the concept of volume of objects to evaluate. The simplest case is, of course, the single product in the usual sense. But the evaluation could also be of a production batch, a product family, an order, a customer etc. In these cases, the determination of the consumption of the different lines of the nomenclature will be trickier because the volume to be taken into account may differ from one line to another.

Take the simple case of the determination of the production cost of a batch of 20 products. On the materials and components lines the volume will be 20, however, on the batch management line the volume will be 1.

If one wants to calculate, for the year, the production cost of a reference *i* of finished products, the management of the trade reference will be unit, the number of batches *n* and the volume of components *np* if the batch size is *p* units.

The complexity of the cost calculation follows the flexibility of the offer and the establishment of nomenclatures becomes a major issue, particularly in the sectors who discover cost calculation such as services which are internal to companies (IT services) or external services (multi-channel banking).

+A1:J17		Resources						Total
Resources		External resources			internal resources			
		ResourceE1	ResourceE2	ResourceEn	Unit of analysis 1	Unit of analysis 2	Unit of analysis 3	
					Internal resource1	Internal resource2	Internal resource3	
	price/Cost	PE1	PE2	PEn	CRI1	CRI2	CRin	
Lines of nomenclature	Volume							
N1	QT	a1						Q1*a1*PE1= M1
N2	QT		a2					Q1*a2*PE2=M2
N3								
N4	QT					b4		Q4*b4*CRI2=M4
N5								
N6	1				b6			Q6*c6*CRI1=M6
.								
Nn	QT/p						bn	Qn*bn*CRIn=Mn
Total cost								**∑Mi**
Object volume	**QT**							
Unit cost								CU=∑Mi/QT

Line of nomenclature	Volume	Unitary consumption	Unit price or unit cost	Montant
Ni	Q	a	PE;CR	M

Figure 3: Structure of systems for calculating costs of simple objects

In a number of cases, the object to evaluate is complex in the sense that it includes other objects themselves subject to assessment. A common illustration is provided by the client object. Evaluation of the latter requires taking into consideration the cost of products that are not specific and that, as such, have lives and interest outside the calculation of the cost of a specific customer.

The previous matrix must be modified to incorporate the cost of these products which will be considered as intermediate objects. If, hypothetically, all products were customer-specific, there would be no need to appeal to this notion of intermediate objects.

In the following matrix, illustrating the case of the client object, the latter uses an external resource, an external service as a facilitator for an event, for example, a number of products whose volume is in the volume column, internal resources such as, for example, the commercial visits (Q6 could, for instance, be equal to 12 for a monthly visit) and administrative management of the customers (Qn could equal 1).

		Resources							Total
Resources		External resources		Internal resources		Intermediate resources			
		ResourceE1	ResourceEn	Unit of analysis 1	Unit of analysis n	Intermediate cost	Intermediate object		
				Ressources Internes 1	Ressources Internes n				
	Price/Cost	PE1	PEn	RI1	Rin		OI2	Oin	
Lines of nomenclature	Volume								
N1	Q1	a1				ca1			QT*a1*(PE1+ca1)= M1
N2	Q2				b2				QT*b2*RIn=M2
N3	Q3								QT*c3*OI1=M3
N4	Q4						c4		QT*c4*OI2=M4
N5	Q5								QT*cn*OIn=M5
N6	Q6								
.									
Nn	Qn			bn					Qn*bn*Rin=Mn
Total cost									**∑Mi**
Object volume	**QT**								
Unit cost								CU=∑Mi/QT	

Line of nomenclature	Volume	Unitary consumption	Unit price or unit cost	Total
Ni	Q	a	PE ; CR ; OI	M

Figure 4: Calculation of cost of any complex object

Even if both matrices are slightly different, the second is only a generalization of the first. This matrix can therefore be considered as a universal calculating machine which, according to the situations, will be mobilized partly or globally.

To become familiar with this new approach to cost calculation, **regardless of any method or any system**, we will examine several situations of increasing complexity.

The underlying cost systems will not be made explicit, they will be reduced to the two entities that are necessary for us: the name of the unit of analysis and the internal resources they produce. In addition to their name, we will add the unit cost of the internal resource.

In the same way, the objects to evaluate will be reduced to their nomenclature and associated with a volume.

These two categories of information will be proposed in literary form and incorporated into our matrix for calculation.

The very small business mono-product

The VSB (very small businesses) is represented by a single unit of analysis, 'Enterprise '. The company produces an internal resource referred to as "production hours", the hourly cost of which has been evaluated at €50.

The object to evaluate is a one-off service. It requires external resources: provision of transport for an amount of €215 and overnight stay in hotel at an amount of €125. The service has consumed 12H.

		Resources			Total
Resources		External resources		Internal resources	
		Transport	Night's board	Enterprise	
				Hours of service	
	Price/cost	215 €	125 €	50 €	
Lines of nomenclature	Volume				
Transport	1	1			215 €
Night's board	1		1		125 €
Hours of service	1			12	600 €
Total cost					**940 €**
Object volume	**1**				
Unit cost					**940 €**

Figure 5 : Unit cost of a service

Consider the case of a small-scale VSB, chair manufacturer. There is only an 'Enterprise' unit of analysis, and as previously, the internal resource produced is production hours, its unit cost is evaluated at €42.

A chair requires several components or materials: 0.01695 m3 of wood, 5 braids of straw and 4 non-slip feet. The m3 of wood is valued at €200, the braided straw €2 and the feet €0.50.

Assembly requires 18 mins.

Production for the month was 375 chairs.

		Resources				
Resources		External resources			Internal resources	Total
		Wood	Straw	Pad	Enterprise	
		M3	Braid	Unit	Hours of production	
	Price/Cost	200,00 €	2,00 €	0,50 €	42,00 €	
Lines of nomenclature	Volume					
Wood	375	0,01695				1 271,25 €
Straw	375		5			3 750,00 €
Pads	375			4		750,00 €
Hours of production	375				0,3	4 725,00 €
Total cost	375					**10 496,25 €**
Object volume	**375**					
Unit cost						**27,99 €**

Figure 6 : Unit cost of a product

The matrix gives us the overall production cost of the period and the unit cost of each chair. The reader will note that the quantity being the same on all the lines (375), it would have been possible to directly determine the unit cost of the chair by replacing 375 by 1 as in the previous case.

Calculation using the overall cost is therefore not an obligation of arithmetic, but is rather a recommendation to familiarize oneself with a method of calculation which becomes mandatory once the BOM line volumes are no longer identical.

SMEs and the complex object

The complexity of the object to produce may require the structuring of the nomenclature. Each level corresponds to the production of a subassembly of the final object. Subassemblies can also be the result of combinations of components etc. The number of levels is not limited. In terms of cost, the existence of levels leads us to resort to what we called intermediate objects, and thus, to break down the calculation of the final object cost into as many steps as there are levels in the nomenclature. We add also a little more complexity in the organization by imagining several units of analysis.

Representation of the Organization

Modeling our Organization leads us to highlight 4 units of analysis, supply, two workshops contributing to the manufacture of subassemblies and a finishing workshop. Each is characterized by an internal resource defined by its name and its value.

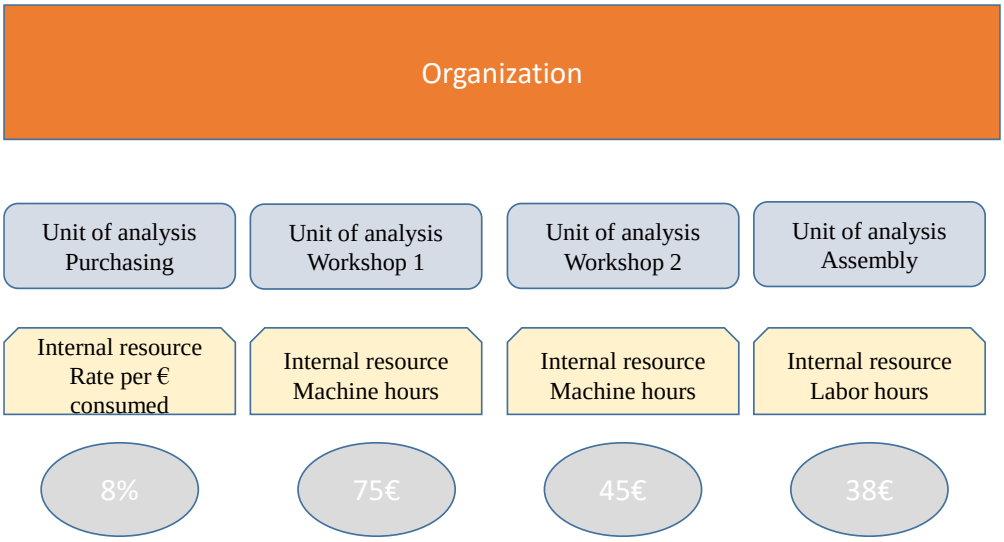

Figure 7: Representation of the SMEs

Representation of the object

Our object is made up of two subassemblies and two parts incorporated at the assembly stage.

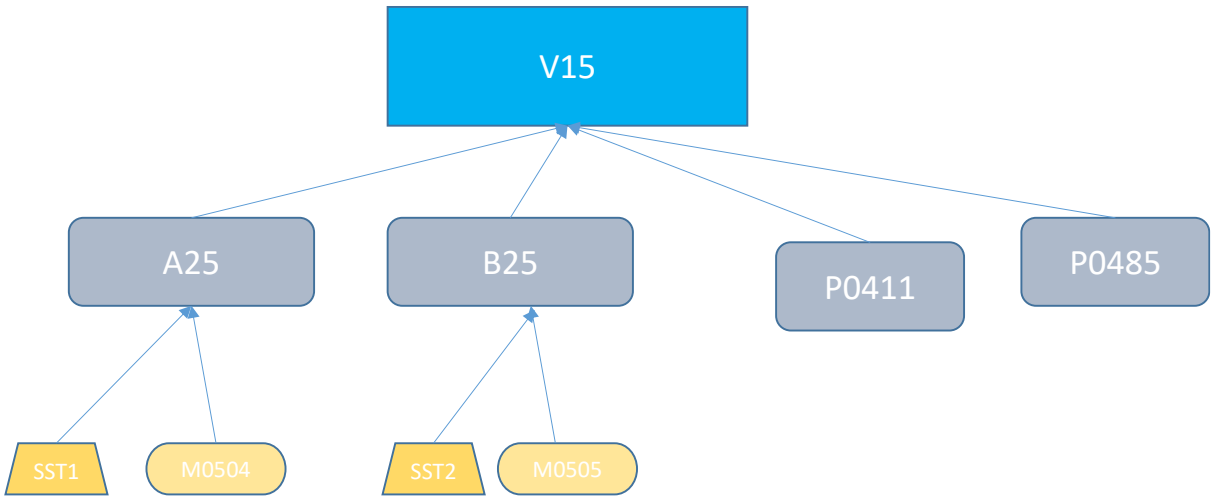

Figure 8 : Technical nomenclature of the V15 object

This technical nomenclature is complemented by information of the operating range and the costs of all the components of the expanded nomenclature.

Reference		Extended nomenclature	Quantity	Units	Unit price
V15					
		A25	1	Unit	
		B25	1	Unit	
		P0411	1	Unit	6,40 €
		P0485	4	Unit	0,28 €
		Assembly	0,5	Labor hours	38,00 €
	A25				
		M0504	0,19	KG	59,50 €
		SST1	1		20,00 €
		Workshop 1	0,25	Machine hour	75,00 €
	B25				
		M0505	0,14	Meter	36,00 €
		Subcontracting	1		40,00 €
		Workshop 2	0,2	Machine hour	45,00 €

Figure 9: Nomenclature extended V15 Object

The missing economic information corresponds to the information provided by the representation of the Organization in terms of units of analysis and internal resources. Everything is in place for the cost calculation of the two subsets (A25 and B25) and subsequently the object V15.

A25		Resources				
Resources		External resources		Internal resources		Total
		M0504	Subcontracting	Supply	Workshop 1	
		Kg	unit	€ consumed	Machine hours	
	Price/cost	59,50 €	20,00 €	8%	75,00 €	
Lines of nomenclature	Volume					
Material M504	1	0,19				11,31 €
Part subcontracted	1		1			20,00 €
Machine hours workshop 1	1				0,25	18,75 €
€ consumed	1			31,31 €		2,50 €
Total cost	1					**52,56 €**
Object volume	1					
Unit cost						**52,56 €**

Figure 10: Cost of the A25 subset

The same operation should be undertaken for B25, this leads to a unit cost of €57.64. The cost of V15 can now be determined by using the costs of the two intermediate objectss: A25 and B25

V15	Resources							
Resources		External resources		internal resources		Intermediate resources		Total
		PO411	P0485	Supply	Assembly	Intermediate objects		
		meter	unit	€ consumed	labor hours	SEA25	SEB25	
	Price/cost	6,40 €	0,28 €	8%	38,00 €	52,56 €	57,64 €	
Lines of nomenclature	Volume							
Part number P0411	1	0,14						0,90 €
Part number P0485	1		4					1,12 €
Sub assembly A25	1					1		52,56 €
Sub assembly B25	1						1	57,64 €
€ consumed	1			2,02 €				0,16 €
Labor hours	1				0,5			19,00 €
Total								**131,38 €**
Object volume	1							
Unit cost								**131,38 €**
€ consumed	2.02€=0.90€+1,12€							

Figure 11: Cost of the V15 object

It should be noted that the calculations were conducted at the unit level. As outlined previously, this option is valid insofar as all internal and external resources are valued at the unit object level in the nomenclature.

Organizations and the complex object

Complexity comes from the abandonment of the unitary relation between the internal resources and the nomenclature representative of the objects. We need to consider several options of consumption of the internal resource produced by the units of analysis. There is no definitive list of these options. However, we can name a few among the most frequent: consumption by reference (for materials and components as for finished products) by batch for resources in production and shipping, for example, by production line, by point-of-sale, etc., the only rule is to make sure of the correspondence between the unit of internal resource produced by units of analysis and the contents of the BOM line describing the object to evaluate.

Consider the following case. We want to determine, within our organization represented by 5 units of analysis, the cost of YYY object whose characteristics are given by the list presented in the following table.

Resources		External resources			Internal resources					Total
		Part number 1	Part number 2	Material 3	Supply	Production management	Manufac-turing	Shipping	Marketing	
		unit	unit	M2	part consumed	batches manufactured	machine hours	batches shipped	product reference number	
	Price/Cost	25	120	5	150	80	60	25	300	
Lines of nomenclature	Volume									
Part number 1	2500	2								
Part number 2	2500		5							
Material 3	2500			3,25						
Supply					?					
Production management	52					1				
Manufacturing	2500						0,085			
Shipping	256							1		
Marketing	1								1	
Total cost										
Object volume	**2500**									
Unit cost										

Figure 12: Calculation of cost in the presence of non-volumic internal resources

The presence of non-volumic internal resources (not directly proportional to the volume of the object) constrains us to opt for the overall cost of the volume of the YYY object. We know the number of manufactured and shipped batches. The YYY object is 1 trade reference. Machine hours are proportional to the volume of the object as external resources. An unresolved question remains: the consumption of the internal resource "consumed reference". If references of components and materials were specific to the YYY object, one could say that this object consumes 3 times the cost of “reference management”. This situation is uncommon, most of the time, a component or material is shared among multiple objects. The cost of the internal resource 'consumed reference' must therefore be allocated throughout the volume of the consumed component 1 and not to the volume consumed by the YYY object. It is the same for component 2 and material 1 in our example. This situation leads us to a specific additional calculation for the components and materials. Its outcome should be treated as an intermediate cost and re-injected into the matrix for the calculation of the cost of the object YYY in the “Intermediate resources” zone.

The following table gives the result of the calculation of the fraction of the “consumed references” internal resource which must be supported by each unit component or material.

		Resources	
Resources		Internal resources	Total
		Supply	Unit cost
		Part number consumed	attributed to each part number or unit of material
	Price/Cost	150,00 €	
Lines of nomenclature	Global volume consumed inside the organization		
Part number 1	12500	150,00 €	0,0120 €
Part number 2	35000	150,00 €	0,0043 €
Material 3	28500	150,00 €	0,0053 €

Figure 13: Calculation of the intermediate cost resulting of the attribution of the part number management cost to each unit of component or material consumed.

Now, we can reintroduce this result into our calculation of the cost of the YYY object.

Resources		External resources			Internal resources				Intermediate resources	
		Part number 1	Part number 2	Material 3	Production management	Manufacturing	Shipping	Marketing	intermediate cost	
		Unit	Unit	M2	ches manufactu	Machine hours	Batches shipped	Product reference number	part number consumed	Total
	Price /cost	25	120	5	80	60	25	300		
Lines of nomenclature	Volume									
Part number 1	2500	2							0,0120 €	125 060 €
Part number 2	2500		5						0,0043 €	1 500 054 €
Material 3	2500			3,25					0,0053 €	40 668 €
Production management	50				1					4000
Manufacturing	2500					0,085				12750
Shipping	256						1			6400
Marketing	1							1		300
Total cost										**1 689 232 €**
Cost object volume	**2500**									
Unit cost										676 €
125060€ = 2500*2*(25+0,0120)										

Figure 14: Global cost and unit cost of YYY object

In the calculation of the cost of the object V15 in the preceding paragraph, the total cost appeared as the addition of basic unit costs for each line of the nomenclature. This technique is no longer usable as some internal resources are independent of the volume of the object to evaluate. It is essential, in this case, to go through the overall cost and deduct the unit cost. This way of operating leads to an important result, i.e. the inability to discuss the basis of the unit cost of the various lines of the nomenclature, with the exception of those which are strictly proportional to the volume of the object. Having separated the purchase price of a component (proportional) from the cost of "consumed reference management", treated as an intermediate cost, this in turn draws attention to the existence of different cost behaviors. This table highlights the fact that action on the cost of the YYY object is specific to each line. For example, the line "production management" depends on 2 independent variables of the volume of YYY: the cost of the internal resource (€80), the number of batches (50), or, and this comes to the same thing, the batch size (2500/50 = 50). For the line "product reference" there is no possible action, the cost of €300 is not divisible, it relates generally to the existence of the YYY object. There are, of course, elements that are strictly proportional to the volume, such as components and materials.

This first example underlines the importance of presentation for the interpretation of cost calculation. A presentation that shows unit cost on each line gives the illusion that everything varies proportionally to the volume, while it is only exceptionally the case. It is therefore always advisable to go through the calculation of the overall cost and to deduce the unit cost.

Multiple objects

The single object, product or service is more and more rare. Either it combines with other objects to be part of a 'solution', or it is customized for markets or segments of customers. Thereby, causing the Organization to call into question the cost of customer or segment service. The complexity can be double when customers are demanding fewer products and more solutions.

Faced with the multiplication of objects for calculating costs and analysis, two options are presented. The first, long used, is to consider that all internal resources must be linked to the initial objects (products, services) and that differentiation between objects of secondary level occurs only through pricing. In this case, the calculation of costs is one of the cases already studied. The second option, more rarely practiced, is to build the cost objects, whatever they may be, focusing on the causal relationships. This means that some external and internal resources will be consumed by first level objects and others by objects at higher levels. Therefore, in order to perform the cost calculation, one must have an in-depth knowledge of the functioning of the Organization in order to avoid allocation errors. We can illustrate this difficulty by different possible treatments of the internal resource “"manufactured batch”. If the organization produces and stores its production, the management cost of the manufactured batch must of course enter into the determination of the product cost under consideration, irrespective of the customer who will buy the product in question. However, if the organization were to launch the manufacture of a specific batch for a given client, then the cost of the internal resource 'manufactured batch' should be posted directly on the 'client' object and not on the "product" object.

Evaluation of the cost of various objects requires prioritizing calculations, from the most basic object to the most encompassing object. In the following illustration we will obtain as previously the cost calculation of the intermediate object ' part number reference management' then the cost calculation of the products and finally the cost calculation of the customers.

The textile outsourcing company is modeled by the 8 units of analysis presented in the following table.

Unit of analysis	Part number management	Handling operation management	Production management	Design management	Stitching	Customer management
Internal resources	Nb of part numbers	Nb of handling operations	Nb of batches	Nb of design	Nb of minutes	Nb of customers
Volume	18	1772	636	5	1893000	10
Unit cost	7 810,85 €	707,02 €	1 398,40 €	174 076,32 €	1,80 €	21 951,05 €

Figure 15: Modelling the enterprise

The company manufactures 5 families of products for two categories of clients, wholesalers and retailers.

The engineering bill of materials and the manufacturing time are given in the following table. The last column gives the unit cost of each of the elements of the BOM. The manufacturing time is represented by stitching minutes, a measure used in the profession. This element of cost will therefore be evaluated by the internal resource "Stitching Minutes”.

Bill of materials						
Design	B1	B2	B3	B4	B5	Unit price of external resources
Fabric						
Cotton inner coat	0,002	0,002	0,0023	0,003	0,003	7,62 €
Elastic lace					0,16	19,82 €
External lace		0,05	0,06	0,08		17,53 €
Knitting 48% poly		0,15				11,13 €
Knitting 90% poly			0,15			11,74 €
Knitting 95% cotton				0,14		13,72 €
English embroidery	0,16					12,20 €
Supplies						
Adjustable straps	2	2	2		2	0,61 €
Fastener	2	2	3	3	2	0,03 €
Bra hook					1	0,03 €
Button and strap				1		0,08 €
Underwire		2	2			0,01 €
Pattern	1	1	1			0,19 €
Lace 5cm				0,35		1,07 €
Lace 8cm				0,4		1,53 €
Elastic ribbon	0,8			0,8		0,38 €
Hanger	1	1				0,08 €
Individual wrapping			1	1	1	0,23 €
Minutes of operation	6,5	11	9,5	13	10	210000
Number of handling operatic	60	69	795	636	212	1772
Volume	90000	57000	30000	22000	11000	**210000**

Figure 16: Extended product nomenclature and production volume

All information necessary for the cost calculation of products is now available. Before addressing calculations one should prioritize simultaneously objects and units of analysis. This is done based on the laws of causality that are translated by the choice of internal resources.

The cost of managing part number references, as in the previous example, is consumed by the references component. These are naturally consumed by products. They also consume the stitching minutes and manipulations representative of the various phases of the progressive assembly of the products. Finally, each product family supports the cost of the creation of the model, the design cost.

We are an outsourcing company that works according to our customers' orders. It is therefore logical to have them bear the cost of production management represented by batch and different costs grouped under the management of the customer.

This is demonstrated in the following diagram.

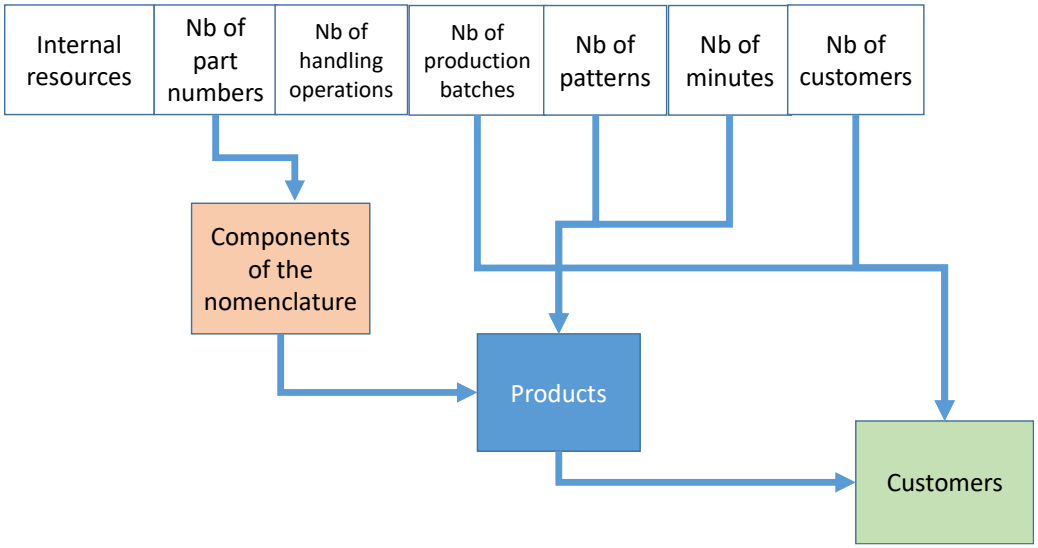

Figure 17: Hierarchy of objects

The calculations can now begin.

The unit cost of the internal resource "Stocked part numbers" is distributed amongst various products according to their consumption of each reference. B1, which is the only one to consume the eyelet, will bear all of the €7811 of this management reference. Each item will bear €7811 / 90000 = €0.54 * 0, 16 or € 0.09.

When the reference is common to several products, the cost of €7811 is shared, based on volume consumed. The cost of the part number management r “Frame” will be shared between both B2 and B3 products on the pro-rata basis of 114000/174000 and 60000/174000. That is €5117 for B2 and €2693 for B3. To know the cost assigned to the unit of product, simply divide by volumes that are 57000 and 30000 respectively, resulting in 0.09 for each, which is logical since both consume 2 frames.

	Part number mangement unit cost	Volume consumed	Unit cost	Nomenclature				
				B1	B2	B3	B4	B5
Product Volume				90000	57000	30000	22000	11000
Fabric								
Cotton inner coat	7 811 €	462	16,91 €	0,002	0,002	0,0023	0,003	0,003
Elastic lace	7 811 €	1760	4,44 €					0,16
External lace	7 811 €	6410	1,22 €		0,05	0,06	0,08	
Knitting 48% poly	7 811 €	8550	0,91 €		0,15			
Knitting 90% poly	7 811 €	4500	1,74 €			0,15		
Knitting 95% coton	7 811 €	3080	2,54 €				0,14	
English embroidery	7 811 €	14400	0,54 €	0,16				
Supplies								
Adjustable straps	7 811 €	376000	0,02 €	2	2	2		2
Fastener	7 811 €	472000	0,02 €	2	2	3	3	2
Bra hook	7 811 €	11000	0,71 €					1
Button and strap	7 811 €	22000	0,36 €				1	
Underwire	7 811 €	174000	0,04 €		2	2		
Pattern	7 811 €	177000	0,04 €	1	1	1		
Lace 5cm	7 811 €	7700	1,01 €				0,35	
Lace 8cm	7 811 €	8800	0,89 €				0,4	
Elastic ribbon	7 811 €	89600	0,09 €	0,8			0,8	
Hanger	7 811 €	147000	0,05 €	1	1			
Individual wrapping	7 811 €	63000	0,12 €			1	1	1

Figure 18: Determination of the "part number management" atributable to each reference

Table (*Figure 18*) generalizes these calculations and allows us to move to the following stage, the product cost calculation considering the result of the calculation that has to be carried out as an intermediate cost (fig 19). We present only the cost calculation of one of the 5 products. The result for the other 4 will be given in synthetic form.

The number of minutes is deducted from the operating range 6,5 mn * 90 000 = 585000.

The number of handling hours is provided by the technical services *Figure 20*

	Part number mangement unit cost	Volume consumed	Unit cost
Product Volume			
Fabric			
Cotton inner coat	7 811 €	462	16,91
Elastic lace	7 811 €	1760	4,44
Exterernal lace	7 811 €	6410	1,22
Knitting 48% poly	7 811 €	8550	0,91
Knitting 90% poly	7 811 €	4500	1,74
Knitting 95% coton	7 811 €	3080	2,54
English embroidery	7 811 €	14400	0,54
Supplies			
Adjustable straps	7 811 €	376000	0,02
Fastener	7 811 €	472000	0,02
Bra hook	7 811 €	11000	0,71
Button and strap	7 811 €	22000	0,36
Underwire	7 811 €	174000	0,04
Pattern	7 811 €	177000	0,04
Lace 5cm	7 811 €	7700	1,01
Lace 8cm	7 811 €	8800	0,89
Elastic ribbon	7 811 €	89600	0,09
Hanger	7 811 €	147000	0,05
Individual wrapping	7 811 €	63000	0,12
Total cost			140595,31

Figure 19: Determination of the cost of "part number management" by product

The result of the calculation is as follows

		Cotton inner coat	English embroidery	Adjustable straps	Fastener	Pattern	Elastic ribbon	Hanger	Handling operations management	Stitching	Design manage	Intermediate cost	
		M2	m	unit	unit	unit	m	unit	one operation	mn	model	part number management	
	Price/cost	7,62 €	12,20 €	0,61 €	0,03 €	0,19 €	0,38 €	0,08 €	707,02 €	1,80 €	174 076,32 €		
Lines of nomenclature	Volume												
Cotton inner coat	90000	0,002										16,91 €	4 414,79 €
English embroidery	90000		0,16									0,54 €	183 490,85 €
Supplies	90000												
Adjustable straps	90000			2								0,02 €	113 539,24 €
Fastener	90000				2							0,02 €	8 378,71 €
Pattern	90000					1						0,04 €	21 071,62 €
Elastic ribbon	90000						0,8					0,09 €	33 636,58 €
Hanger	90000							1				0,05 €	11 982,15 €
Handling operations managem	60								1				42 421,20 €
Stitching	90000									6,5			1 053 000,00 €
Design management	1										1		174 076,32 €
Total cost													1 646 011,46 €
Unit cost	90000												18,29 €

Figure 20: The B1 product cost

For other products, the calculation yields the following results: B1, 18, €27. B2, €28.3; B3, €46.93; B4, €58.59; B5, €53.59.

We are now able to move to the calculation of the cost of the clients. They consume products and both types of remaining internal resources: batch management and customer management.

The information system must provide information about the type and volume of products purchased as well as the number of lots manufactured for these deliveries.

Consider the case of two clients: a specialist client who absorbs all production of B1 and a wholesale customer who orders 4,000 B3 products, 3000 B4 and 500 B5. This production has called for the scheduling of 65 batches for B3, 31 for B4 and 10 for B5 a total of 106 lots. Moving from the "product "level to the "Customer" level, all product costs became intermediate objects which must be integrated in the intermediate resources to obtain the total cost of the customer.

		Internal resources		Intermediate resources	Total
	Unit of analysis	Production management	Customer management	intermediate object	
	Internal resource	Nb of batches	Nb of customers	B1	
	Price/cost	1 398,40 €	21 951,05 €	18,27 €	
Customer 1	Volume				
Nb of batches	30	1			41 952 €
Nb of customers	1		1		21 951 €
Product B1	90000			1	1 644 517 €
Total					1 708 420 €

Figure 21: Overall cost of Client 1

		Internal resources		Intermediate resources			
		Production management	Customer management	Intermediate objects			
Client 6		Nb of batches	Nb of customers	B3	B4	B5	
	Unit cost	1 398,40 €	21 951,05 €	46,93 €	58,59 €	53,90 €	
	Volume						Total
Nb of batches	106	1					148 230 €
Nb of customers	1		1				21 951 €
Product B3	4000			1			187 720 €
Product B4	3000				1		175 770 €
Product B5	500					1	26 950 €
Total							560 621 €

Figure 22: Overall cost of customer 6

It should be noted the considerable weight of the cost of the batchs management for client n° 6. Seemingly the latter works primarily by restocking and requesting batches of 70 parts (on average) while client n° 1 orders batches of 3000.

We have finished with the presentation of the different configurations for the cost calculations that may arise, from the simplest to the most complex. At no time, have we discussed the method of construction of the representation of the Organization, obviously varied but nevertheless the organization of the cost calculations remains identical. This indicates that this technical aspect, generally dealt with by software programs, can be disconnected from the reflection on the managerial and informational aspects that accompany the implementation of a cost system.

Conclusion

The purpose of this chapter has been to show, using a unique technical support, the simplicity of the calculation of actual cost. Regardless of the Organization and its complexity, regardless of the objects, their complexity and their diversity, the calculation approach remains the same. It comes down to the intersection of the representation of the Organization in the form of units of analysis and that of objects in the form of nomenclature. The units of analysis are characterized by three attributes: their name, production unit of measure, and the unit cost of this production, named, here, internal resource. Nomenclatures of objects list all of the resources that are necessary for their development, whether external or internal resources. In the case of complex objects and hierarchical nomenclatures, it may be useful to break down the calculation per level and calculate the cost of intermediate objects whose assembly will give the final object.

Great attention must be paid to the modalities of resource consumption, especially internal resources. These terms reflect causal laws which are essential for the utilization of the results.

All these points will be developed in the following chapters so as to gradually build the analytical framework needed to assess the relevance of increasingly diverse cost systems that are available today.