Calculating Hourly Cost Rates In Project-Based Industries – Part 2: cost management

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Abstract: Hourly cost rates are crucial project costing due to the substantial proportion of labor costs in projects. Yet, there is little published about calculating hourly cost rates, and it is a contentious topic in corporations. Therefore, an approach is provided in this paper that will improve the calculation of hourly cost rates. It is based on a novel approach to Activity-Based Costing (ABC) and a revised version of the CAM-I Capacity Model which is adopted to project-based industries. Both an example and a case are provided to allow detailed discussions.

Keywords: Capacity, Earned Value, Activity-Based Costing, subcontracting, shipbuilding, construction, fabrication.

1 Frame of reference

Projects normally have a dismal success rate, and the causes are many as we see from the literature. However, one important cause that is hardly discussed is that the capacity management is faulty for medium-sized projects in project-based industries, as discussed in Part 1, see (Emblemsvåg and Cokins 2020), of this two-part paper. This not only means that the whole basis for project costing is wrong, but also that decisions are made from the wrong basis – consistently. Since project-based industries manage costs mostly with procured cost items and labor hour costs, the hourly cost rate is of major importance. Indeed, according to (Kummer 2017), the labor consumption cost rate is the single most important indicator for planning and preparing forecasts in construction management and economics as well as assessing labor-intensive activities. However, with faulty capacity management that hourly cost rate will be wrong, as illustrated in a simple example in (Emblemsvåg and Cokins 2020).

Since corporations often want the hourly cost rates to include overhead costs (in addition to the direct cost such as wages, social costs, and protective equipment, etc.) for cost management purposes (Eden and Ronen 1991), the problems of calculating correct hourly cost rates increases in complexity in addition to the capacity modeling discussed in Part 1, see (Emblemsvåg and Cokins 2020). The assignment of overhead costs becomes another contentious topic. Hence, to calculate correct hourly cost rates we need not only correct capacity modeling, but also correct handling of overhead costs.

Since most corporations treat capacity incorrectly, see (McNair and Vangermeersch 1998), and conventional costing systems mistreat overhead costs, see Section 4, it follows that there are not many calculating hourly cost rates correctly in such industries. Incredibly, from the literature review in Section 2, we also find that the calculation of hourly cost rates is a topic virtually without academic discourse. This is, of course, one reason why so many people calculate the hourly cost rate erroneously – it has simply not been a topic of neither academic research, teachings nor discourse of practice. Indeed, many textbooks in schools and universities alike are not up to date as to how capacity should be modeled, see (McNair and Vangermeersch 1998).

Furthermore, we suspect that the project management function has assumed that the hourly cost rate received from the finance function is correct and never challenged or questioned. Unfortunately, the finance function has had an external focus and adhered to the Generally Accepted Accounting Principles (GAAP) for external financial compliance and statutory reporting for government regulators and the investment community. The finance function has less internal focus with relevant management accounting until relatively lately, as described in greater detail in (Emblemsvåg and Cokins 2020). As a consequence of this imbalance of external versus internal accounting, there is little/nothing published on the hourly cost rates used in project-based industries.

The second reason why hourly cost rates are calculated incorrectly is that the capacity models used to fall short of being valid producing flawed and misleading data. This is discussed in greater detail in (Emblemsvåg and Cokins 2020) to which the interested reader is referred. Furthermore, readers not fluent in ABC or capacity management would also greatly benefit from reading before reading on here.

We have so far shown that conventional approaches are deficient in project-based industries where the projects are of medium size and often found in industries such as Construction, Shipbuilding, and general Fabrication, see Section 2 and (Emblemsvåg and Cokins 2020). They fail to distinguish between the supply- and demand for capacity. They model capacity incorrectly, incorrect amounts of overhead costs are assigned, and the hourly cost rates become miscalculated. Then, the research question logically becomes:

RQ1 – how should correct hourly cost rates be calculated in project-based industries with medium-sized projects?

Based on the discussion so far, including the review to come in Section 2, ABC is considered the proper approach for calculating the hourly cost rate correctly. Hence, we hypothesize:

H1: Activity-Based Costing and a revised CAM-I capacity model provide the basis for calculating hourly cost rates correctly in project-based industries where the projects are of medium-size.

This hypothesis will be tested through inductive reasoning in the context of action research and the literature. We will explore the possible approaches found in the literature, discuss their merits and issues, identify how it can be improved and apply it in a case. From this, we will argue what is likely to be the correct approach towards calculating hourly rates for project-based industries with medium-sized projects.

Before we come that far we provide a literature review in Section 2 to demonstrate that our approach is novel and that it also solves issues so far incorrectly treated. Then, in Section 3, a short introduction to Activity-Based Costing (ABC) is provided to highlight some key concepts necessary to understand in order to calculate hourly cost rates correctly. Section 4 provides an adjusted version of the CAM-I model since project-based industries have some peculiarities as shown in (Emblemsvåg and Cokins 2020). Based on the discussion thus far we present a correct approach in Section 5 for determining the hourly cost rates for project-based industries that have midsized projects. The arguments are expanded to a real-life case in Section 6. Note that the real-life case is scrambled, but it nevertheless shows how costs should be calculated correctly and contrasted to a conventional approach. This provides a basis for accepting the research hypothesis. A closure is provided in the final section.

2 Literature review on determining hourly cost rates in project-based industries

There is remarkably scant literature about calculating hourly cost rates in project-based industries whereas in manufacturing-related literature the capacity part of the topic is a major topic as briefly discussed in (Emblemsvåg and Cokins 2020). A search using a broad keyword as 'hourly rate' at Google Scholar, Science Direct and Scopus produced no relevant results except one paper – (Eden and Ronen 1991). A search on the internet using Google produced thousands of hits on wages for project participants and some standard calculation methods for hourly wages for individuals presented in sources that are neither research-related nor peer-reviewed. We can only speculate why there has been so little written, as done a couple of places so far in the paper.

Without speculating, (Eden and Ronen 1991) also lament the state of practice concerning hourly wage rates. They acknowledge that it is often used as a decision-making tool, but often incorrectly, which is our observations as well. However, also (Eden and Ronen 1991) ignore the project world. Thus, to the best of our knowledge, there is nothing written about calculating hourly cost rates for project-based industries. A search at the pmi.org website illustrates the case very well, there is much written about calculating costs but there is not a single instance concerning how to calculate the hourly cost rates used. As mentioned before, the only logical explanation is that this is seen as the role of the finance function. Arguably, this makes sense, and in (Emblemsvåg and Cokins 2020) the sorry state of finance is well described.

Before continuing, it should be noted that there are some papers introducing ABC to projects, but they address other issues. For example, (Raz and Elnathan 1999) discuss ABC in projects as a replacement of the Work Breakdown Structure (WBS), but in so doing they ignore the fact that, for example, purchasing orders can vary greatly in details and efforts in projects making it inappropriate as activity driver. We believe that replacing the WBS is one step too far simply due to the lack of repeatability in projects also at the process level, as explained later. Another thing is that the WBS is a great organizing tool in project planning, see (Emblemsvåg 2014a; Fleming and Koppelman 2005), and doing away with that will have far-reaching consequences well beyond the scope of the discussion concerning hourly cost rates.

The paper that comes closest to what we are researching is (Kim and Ballard 2001) where they explore ABC in the context of construction projects in the context of Lean Construction. Unfortunately, they do not explore ABC to the depth required for our purpose.

This means that for project-based industries, particularly those having medium-sized projects, there is little to directly use from the literature. This concerns not only the way capacity is modelled, as discussed in Part 1, (Emblemsvåg and Cokins 2020), but also how overhead costs are traced and assigned to cost objects, which is why we use ABC in the remainder of this paper. The logic of ABC is therefore explicated next.

3 Brief introduction to the ABC concept

ABC is a costing system that is based on the formulations of resources, activities and cost objects as shown in **Figure 1**, and they are defined as follows:

- 'Resources' is everything the organization uses to operate. Resources have a capacity measured as the expense and a demand measured as 'cost'.
- 'Activities' is what work, labor, and equipment, is actually being done in the organization. Groups of activities with certain commonalities are commonly referred to as processes, activity centers, departments and so on depending on what commonality is used.
- 'Cost objects' are the objects, typically products, service-lines, distribution channels, and customers, for which we want the separate cost, revenue and profit statements. In this paper, the cost object is an hour for a certain resource type that is relevant for the project.

These elements interact as follows; the cost objects consume activities, which in turn consume resources. Thus, ABC is conceptually a *two-stage* costing system based on cause-and-effect relationships, often referred to as *costing's causality principle*. In real life, the ABC system becomes a multi-stage costing system due to the inherent complexities of most corporations.

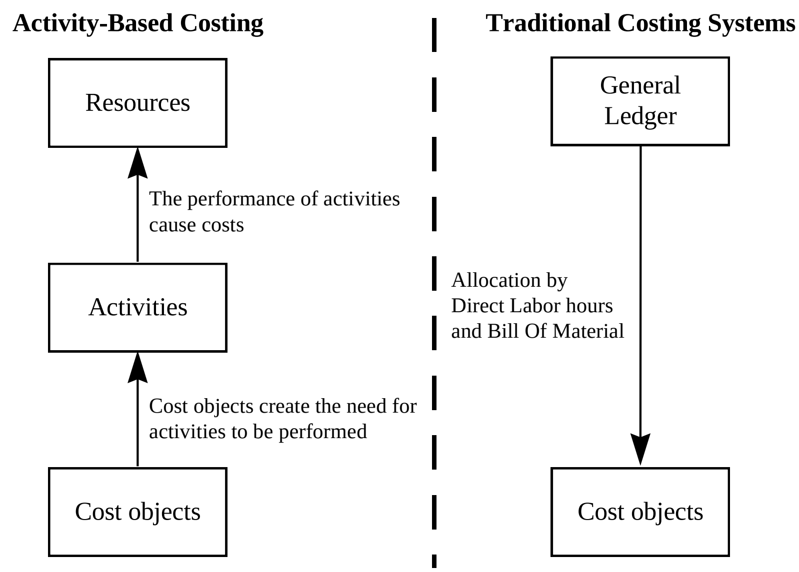

Figure 1 – Main Principles of Activity-Based Costing versus Traditional Costing Systems (Emblemsvåg 2003).

It should be noted that the arrows in ABC in **Figure 1** go upwards whereas the arrows in traditional/conventional[1] costing systems go downwards. This is to signify that ABC reflects a consumption view. ABC is resource-oriented directing capacity supplied from demand required, which is estimated by aggregation – hence upward arrows.

Traditional costing systems, in contrast, simply allocate the capacity without any considerations of cause-and-effect relationships. Thus, the arrows go downwards. This allows ABC to cost the demand correctly. Traditional costing systems, however, take the expenses as given and equals expenses and costs. Indeed, equating expenses and costs is so common in daily parlance that we hardly make the distinction, but when we estimate hourly cost rates and the resulting costs, we must do it correctly.

Moreover, the traditional costing systems are a one-stage costing system without any process perspective, and hence the costs are allocated directly to the cost objects usually using highly volume-related cost allocation bases such as the number of direct labor hours and machine hours. According to (McIllhattan 1987), 94% of the companies used labor hours to allocate overhead costs. Unfortunately, the adoption rate is still very low so the ratio of companies using such allocation bases is still very high. In project-based industries, it is probably close to 100%.

The difference is important to notice because it implies that ABC is process-oriented whereas traditional costing systems are not. Put differently; ABC is based on what *really* happens while traditional

[1] Note that in the literature the terms 'traditional', 'conventional' are used to essentially denote the costing systems that are volume-related, see (Emblemsvåg 2003).

costing systems are based on the organizational structure and volume. There are many implications of this, and the interested reader can consult (Cokins 2001; Cokins *et al.* 1992; Edwards 1998; Emblemsvåg 2003; Turney 1991) for more details[2], but one very noticeable implication is those cost calculations performed in the volume-based approach can be several hundred percent off (O'Guin 1990). Indeed, according to (Cooper 1990a):

> *Conventional cost accounting systems systematically undercost small, low-volume products and overcost large high-volume products.*

When this was discovered in the early 1980s, traditional approaches were therefore described in the literature as 'lacking relevance' (Johnson and Kaplan 1987), being 'number one enemy of production' (Goldratt 1983), 'undermining production' (Kaplan 1984), and 'systematically distorting product costs' (Johnson and Kaplan 1987). The question has even been asked whether cost accounting is an asset or a liability (Fox 1986). This is the other reason for using ABC, and ABC will be discussed later in Section 2. In fact, it was the introduction of ABC that brought the capacity cost management discussions back onto a correct path after several 'dark decades', see (McNair and Vangermeersch 1998) for a full description.

The insight from (Cooper 1990a) is also relevant for project-based industries. Projects are by default low-volume 'products', and from (Cooper 1990a) it follows that costs should normally be underestimated as well. This is indeed what is often the case; projects frequently fail to meet their cost targets as pointed out in (Powner 2008), (Flyvbjerg *et al.* 2012) and many more. Sure, poor execution is one reason, but also faulty initial cost calculations and optimism during tendering. From the discussion so far, we understand that this is, in fact, inherent to the poor quality of the costing system used – ABC is, therefore, a need, not an option.

Before leaving this topic, we would like to discuss in greater detail why replacing the WBS is not a good approach. The WBS is defined as "a deliverable-oriented hierarchical decomposition of the work to be executed by the team" (PMI 2008). It often forms the basis for clocking hours in the project because it is used in project planning and control. Normally, it is also used for calculating the costs as well as plan future, similar projects. From a project costing perspective, the WBS, therefore, allows the corporation to directly relate the hours worked to the deliverable by clocking the hours according to the WBS structure.

[2] It should be noted that later on, (Kaplan and Anderson 2007) presented the time-driven version of ABC in order to reduce their perceived complexity of the initial ABC framework. Personally, having worked with ABC for decades, we find little merit in this later version simply because the complexity of the initial ABC is easy to manage, see for example (Emblemsvåg 2004).

Note, that because the WBS is hierarchical it can also aggregate costs into the higher levels of the WBS all the way until we have the cost of the complete scope of work.

Therefore, the WBS allows the corporation to directly attribute the costs to the deliverable except overhead costs. Since direct attribution of costs gives the most accurate assignment of costs, we propose to use the WBS as before because it gives an accurate overview of hours spent and where they are spent, but to adjust the hourly cost rates used according to ABC principles. Since the overhead costs in project-based industries typically vary from 20 – 40%, according to (Raz and Elnathan 1999), which means that most costs are direct costs, it is better to keep the WBS and the clocking of hours but simply adjust the hourly cost rates to better reflect true overhead costs, than to do away with the whole WBS. Also keep in mind that the WBS also serves other purposes such as scheduling, component identification, etc.

To calculate the hourly cost rates correctly, one theoretical foundation is still missing. We need to adjust the CAM-I model to projects, as alluded to earlier. Next, a summary of the discussion in Part 1 is provided for completeness.

4 The CAM-I model for projects

The adjusted version of the CAM-I Capacity Model for project-based industries where the projects are of medium size is presented in Figure 2. Two crucial differences between manufacturing – for which the I-CAM Capacity Model was developed – and project-based industries such as Fabrication, Shipbuilding, and Construction, are that;

1. In manufacturing and similar industries, products and services are predefined, i.e., developed before being offered to the customers. In project-based industries, however, the product is delivered as a project, see (Emblemsvåg 2014b, a), through a collaborative process between customer and supplier.
2. Manufacturing is based on largely repetitive processes whereas projects are often based on relatively unique processes in comparison.

This results in a number of implications that were taken into account when revising the I-CAM Capacity Model for project-based industries in Part 1, (Emblemsvåg and Cokins 2020):

3. Idle capacity consists of only two types – marketable capacity and not marketable capacity. The latter is due to capacity imbalances in cases where capacity constraints apply because they cannot be resolved using subcontracting. If such capacity constraints do not apply, then all idle capacity is in

principle marketable due to the possibility of subcontracting work either externally to the project or use subcontractors in the project.

4. The non-productive capacity is quite different from the CAM-I Capacity Model. This is because yield losses, standby, and setups are treated as a part of reality in project execution and normally never tracked. Maintenance, scrap and rework are tracked, however. It may be surprising to find Research & Development (R&D) and process improvement as non-productive capacity, but this is because in project-based industries such activities are much riskier than elsewhere since the scope of work changes from contract to contract. Furthermore, they often remove capacity from productive capacity hitting both the revenues side as well as the cost side.
5. Productive capacity is what contributes towards the projects through project execution, but it can at times also include process development not directly warranted by the scope of the project but profitable enough to be performed and paid-off through the project execution.

Next, we will put all our findings together in an activity-based approach for calculating hourly cost rates. Then, in Section 6, we will describe a real-life case where the numbers have been scrambled for confidentiality purposes. We will test several variants of an activity-based approach and then discuss and analyze to test Hypothesis 1.

Rated Capacity	Model Summary	Industry Specific Model	Strategy Specific Model	Traditional Model
Rated Capacity	Idle	Not Marketable	Capacity Imbalance due to Project Portfolio Mix	Theoretical
		Marketable	Idle, but Usable	Practical
	Non-productive	Research & Development		Scheduled
		Process Development		
		Maintenance		
		Waste	Scrap	
			Rework	
	Productive	Immediate Process Development		
		Project Execution		

Figure 2 – CAM-I Capacity Model adjusted for project-based industries.

5 An approach to correctly determine hourly cost rates

The basic premise of cost management is to strike the right balance between relevance and accuracy – it is better to be approximately right than exactly wrong (Kaplan and Cooper 1999). Since project-based industries are characterized by a large number of uncertainties and random variations., see (Koskela 1992) for an excellent discussion, this is very important to take into account when calculating the hourly cost rates.

Naturally, this has important ramifications concerning an ABC model, as well. First, the level of detail must be limited. The level of detail and accuracy depends on the types of decisions the cost information will be used for. Most decisions simply need to be "good enough". The best way to ensure this while at the same time maintain the highest degree of relevance is to ensure the best possible fit between hourly cost rates and the activity cost pools. Furthermore, by limiting the number of types of hourly cost rates to what is only needed, there will be a relatively large cost pool, but with a manageable vital few cost pools.

A key to sustaining the use of a costing system is to right-size it. Its size and complexity should not go beyond the point of diminishing returns in extra accuracy for the extra effort to collect, validate, calculate, and report the cost information. One should ask, "Is the higher climb worth the better view?" This way of thinking is independent of the various alternative approaches – it is generic to ABC. It will, however, be shown how such ABC models become.

Another key issue is how the capacity issue is handled, as discussed in Part 1 and summarized here for completeness. For instance, **Table 1** illustrates a fact in project-based industries – they have some capacity of their own employees and they subcontract the rest of the scope of work. Note that HSEQ is a common abbreviation for the Health, Safety, the Environment and Quality function. We see that there is 48% idle capacity. Keep in mind that the usage of subcontractors is not only a capacity issue but also related to timing and competence. In some cases, it can also be defined in the contract with the customer.

Table 1 – Illustrative example of capacity in companies having projects with subcontractors.

	Net own capacity [h]	External capacity [h]	Sum [h]	Demand [h]	Over-capacity [h]
Engineering	15 030	4 500	19 530	10 500	9 030
Production, workers	62 625	55 000	117 625	83 300	34 325
Production, other	9 500	1 500	11 000	7 000	4 000
HSEQ	8 000		8 000	6 500	1 500
Project management	4 500	500	5 000	4 500	500
Sum	**99 655**	**61 500**	**161 155**	**111 800**	**49 355**

Based on the discussion in Part 1 and here, we can now outline an approach based on three steps:

1. Determine maximum practical.
2. Determine demand.
3. Integrate the findings from steps 1 and 2 into a high-level ABC model to estimate the hourly cost rates.

All this can be solved by devising a special case of an ABC model. To understand how, a case is best suited and presented in the next section.

6 Using ABC to correctly determine hourly cost rates

The case is a real-life case where we have scrambled the numbers to avoid the wrong focus and any confidentiality issues. Tables 2 – 5 are further expansions of the example in Table 1, and we see how ABC can be used. The corporation wanted four types of hourly cost rates for project calculation purposes as well as reporting. Consequently, the entire ledger has been designed in such a way that there is as much direct attribution as possible. This is critical to reducing distortions in the model. There are only two major cost pools left for which we must assign costs using resource drivers – Management & Sales and Finance. The sum of these pools is often referred to as SG&A (Sales and General Administration), and it constitutes 16% of the total expenses.

It is important to choose drivers that as closely as possible reflect the way activities actually are consumed as possible, see e.g. (Cooper 1989). Since management and sales in project-based industries have often focused more on large projects than on small projects, it is relatively safe to assume that the number of hours is a good resource driver. For Finance, however, the activity is different. Here, it is the number of financial transactions that largely determine the efforts. Since keeping track of the transactions in these large cost pools would require an extra level of classification, it is simpler to just use the number of costs as a resource driver.

So far, we have discussed typical ABC issues. Since ABC is better than traditional costing systems, proven through academic discourse and practice for decades, we do not introduce traditional costing issues into the case. In the remainder of this case, we will therefore only illustrate various ways of using capacity and demand figures and discuss their merit and problems to verify Hypothesis 1.

From Table 1, we see that the number of subcontracted hours is greater than the hours worked by the people employed in the company. Which hours to use is therefore crucial. In Sections 6.1 – 6.4, four different ways are presented and discussed all based on an ABC framework. Then, in Section 6.5 we discuss and summarize the findings and relate them to Hypothesis 1.

6.1 Alt 1: Calculating hourly cost rates using ABC based on own capacity

The first alternative is based on the capacity of the company itself, i.e., ignoring subcontracting altogether, see **Table 2**. This gives the hourly cost rates presented at the bottom of the table for each cost pool (Engineering, Production, HSEQ and Project management). One problem with this approach is that it implicitly assumes that subcontractors do not require any overhead resources for their scope of work. Apart from the fact that this is obviously untrue, subcontractors will also be perceived as cheaper than their own employees, and this will over time lead to an erosion of the employment base in the company.

The long-term problem of this initial problem leads to the second problem; the fewer people the company employs, the higher will the hourly cost rate of these people becomes and the more difficult it becomes to sell new projects. Thus, this approach will always produce too high hourly cost rates.

This leads in turn to a third problem, there will be substantial differences in project profitability depending on whether it is subcontractors performing the scope of work or the employees of the company (ignoring any productivity differences). Then, we have essentially a malfunctioning cost management system, and the behavioral issues can eventually become severe. Thinking about behavior is important when designing costing systems (Cooper 1989).

A final problem is that the sum of project profitabilities becomes the profitability of the company thus ignoring unused capacity altogether. This builds waste into the system. Clearly, this approach has many, severe problems which render it unsuitable.

Next, we take a different approach using the actual demand for calculating the hourly cost rates – but in an ABC framework.

Table 2 – Hourly rates [NOK/hr] calculated from own capacity in an ABC framework.

Expense centers	Indirect resource driver		Total Indir. exp.	Engineering	Production	HSEQ	Project mgt
				Direct cost centers			
Project mgt	Direct attribution		2 300 000				2 300 000
Production	Direct attribution		34 610 000		34 610 000		
Engineering	Direct attribution		5 560 000	5 560 000			
Management & Sales	Number of own hours	99 655	5 250 000	15 030	72 125	8 000	4 500
HSEQ	Direct attribution		5 000 000			5 000 000	
Finance	Indirect costs	52 720 000	2 000 000	6 351 807	38 409 671	5 421 454	2 537 068
Assigned expenses	13 %		7 250 000	6 366 837	38 481 796	5 429 454	2 541 568
Directly attributed expenses			47 470 000	5 560 000	34 610 000	5 000 000	2 300 000
Total expenses			**54 720 000**	**11 926 837**	**73 091 796**	**10 429 454**	**4 841 568**
Expense centers	**Indirect resource driver**		**Total Indir. exp.**	**Direct cost centers: Engineering**	**Production**	**HSEQ**	**Project mgt**
Cost pool direct attribution	Direct attribution		47 470 000	5 560 000	34 610 000	5 000 000	2 300 000
Management & Sales	Number of own hours	5 250 000	5 250 000	791 807	3 799 671	421 454	237 068
Finance	Indirect costs	2 000 000	2 000 000	240 964	1 457 120	205 670	96 247
Assigned expenses	13 %		7 250 000	1 032 771	5 256 791	627 124	333 315
Directly attributed expenses			47 470 000	5 560 000	34 610 000	5 000 000	2 300 000
Total expenses	**OK**		**54 720 000**	**6 592 771**	**39 866 791**	**5 627 124**	**2 633 315**
Calculated hourly rate			549	439	553	703	585

6.2 Alt. 2: Calculating hourly cost rates using ABC based on budgetary capacity

In this case, the budgetary capacity is higher than the company's own capacity, which means that the weighted average hourly cost rates drop (549 versus 489). The mix changes also so that some hourly cost rates increase and others decrease, but overall it drops. This is evident from comparing the hourly cost rates in **Tables 2 and 3**. The approach has, however, some fundamental flaws.

By using budgetary capacity as a basis, the hourly cost rates will fluctuate according to demand. This makes financial planning and reporting difficult, but it is also wrong logically speaking. Waste is still built into the system making it impossible to find ways of using cost management to improve the corporation.

This approach also mixes economic value with cost. The pricing of the capacity is such that the more demand, then the lower the cost, which is exactly the opposite of what all known economic theory holds. What is true, however, is that the more demand the higher the economic value, but in this approach, it becomes the opposite. Therefore, the approach mixes economic value and cost, and it is therefore deceptive.

Behaviorally speaking, it will promote volume and become self-reinforcing in that the more the salesforce sells, the cheaper it gets and *vice versa*. This echoes a similar problem discussed in Section 6.1 but on a grander scale since total demand is likely to vary more than the capacity. The changes in the hourly cost rates from Table 2 compared to Table 3 illustrates this.

Next, a better approach is presented.

Table 3 - Hourly rates [NOK/hr] calculated based on actual demand (budgetary capacity) in an ABC framework.

Expense centers	Indirect resource driver		Total Indir. exp.	Direct cost centers Engineering	Production	HSEQ	Project mgt
Project mgt	Direct attribution		2 300 000				2 300 000
Production	Direct attribution		34 610 000		34 610 000		
Engineering	Direct attribution		5 560 000	5 560 000			
Management & Sales	Number of own hours	111 800	5 250 000	10 500	90 300	6 500	4 500
HSEQ	Direct attribution		5 000 000			5 000 000	
Finance	Indirect costs	52 720 000	2 000 000	6 053 068	38 850 385	5 305 233	2 511 315
Assigned expenses	13 %		7 250 000	6 063 568	38 940 685	5 311 733	2 515 815
Directly attributed expenses			47 470 000	5 560 000	34 610 000	5 000 000	2 300 000
Total expenses			**54 720 000**	**11 623 568**	**73 550 685**	**10 311 733**	**4 815 815**
Expense centers	**Indirect resource driver**		**Total Indir. exp.**	**Direct cost centers Engineering**	**Production**	**HSEQ**	**Project mgt**
Cost pool direct attribution	Direct attribution		47 470 000	5 560 000	34 610 000	5 000 000	2 300 000
Management & Sales	Number of own hours	5 250 000	5 250 000	493 068	4 240 385	305 233	211 315
Finance	Indirect costs	2 000 000	2 000 000	229 631	1 473 839	201 261	95 270
Total expenses	**OK**		**54 720 000**	**6 282 699**	**40 324 223**	**5 506 493**	**2 606 585**
Calculated hourly rate			489	598	447	847	579

6.3 Alt. 3A: Calculating hourly cost rates using ABC based on maximum practical capacity

None of the two approaches previously discussed handles capacity correctly although they handle the overhead costs correctly using ABC. That is, the overhead is handled the right way but results in the wrong numbers because capacity and demand are treated incorrectly. Now, the correct capacity – maximum practical capacity – is used, see **Table 4**.

By comparing to **Tables 2 and 3**, we see that the hourly cost rates drop even more and the mix changes once more. This approach has solved all the challenges discussed earlier except one – the cost of unused capacity is still not directly dealt with on the expense center level. That is, the cost of the unused capacity in Production is unclear. However, the hourly cost rates will be quite close to the real hourly cost rates, see **Table 4**. The only approach that does it all correctly is, therefore, the one presented next, which offers a more explicit approach to demand versus capacity than Alternative 3A.

Table 4 – Hourly rates [NOK/hr] calculated from maximum practical capacity in an ABC framework.

Expense centers	Indirect resource driver		Total Indir. exp.	Direct cost centers: Engineering	Production	HSEQ	Project mgt
Project mgt	Direct attribution		2 300 000				2 300 000
Production	Direct attribution		34 610 000		34 610 000		
Engineering	Direct attribution		5 560 000	5 560 000			
Management & Sales	Number of hours	161 155	5 250 000	19 530	128 625	8 000	5 000
HSEQ	Direct attribution		5 000 000			5 000 000	
Finance	Indirect costs	52 720 000	2 000 000	6 196 235	38 800 259	5 260 619	2 462 887
Assigned expenses	13 %		7 250 000	6 215 765	38 928 884	5 268 619	2 467 887
Directly attributed expenses			47 470 000	5 560 000	34 610 000	5 000 000	2 300 000
Total expenses			**54 720 000**	**11 775 765**	**73 538 884**	**10 268 619**	**4 767 887**
Expense centers	**Indirect resource driver**		**Total Indir. exp.**	**Direct cost centers: Engineering**	**Production**	**HSEQ**	**Project mgt**
Cost pool direct attribution	Direct attribution		47 470 000	5 560 000	34 610 000	5 000 000	2 300 000
Management & Sales	Number of hours	5 250 000	5 250 000	636 235	4 190 259	260 619	162 887
Finance	Indirect costs	2 000 000	2 000 000	235 062	1 471 937	199 568	93 433
Assigned expenses	13 %		7 250 000	871 297	5 662 196	460 187	256 319
Directly attributed expenses			47 470 000	5 560 000	34 610 000	5 000 000	2 300 000
Total expenses	**OK**		**54 720 000**	**6 431 297**	**40 272 196**	**5 460 187**	**2 556 319**
Calculated hourly rate			340	329	313	683	511

6.4 Alt. 3B: Calculating hourly cost rates using ABC based on maximum practical capacity and idle capacity identification

If we compare **Table 7** to **Tables 2** through 4, an obvious change is identifiable – an explicit difference between expense and cost is introduced. Expenses are the capacity supplied (maximum practical capacity) and its cost is the capacity utilized (the demand). The difference is the idle capacity. We see that with the current load, there is about 16 MNOK idle capacity. In all the previous approaches, this amount of money would have been smeared out (like the butter across bread) over the hours and hence into the project cost when it really is an idle capacity of the corporation. Out of the total expenses, this constitutes 30% which essentially becomes a cost disadvantage for corporations that follow the approaches in Tables 4 through 6 compared to a corporation doing it correctly as shown here.

The benefit of this approach is that by making visible the cost of idle capacity we have several managerial options, which is what cost management should be about (as opposed to finding ways to smearing out the costs). Clearly, management will see that with the current load there is 16 MNOK of idle capacity, and they can start investigating ways of reducing this capacity if they have reason to believe that demand will not recuperate within a reasonable time.

Note that what we often call cost-cutting is really expense cutting, i.e. reducing capacity. With this costing system, we can identify both where and how much capacity can be cut without impacting the value-creating activities. Without this insight, cost-cutting can do more harm than good. One might cut through the fat into the bone. Alternatively, management also knows that 30% in effect is a profit hurdle rate for the projects to provide sufficient funding for the idle capacity so that the company does not lose money. Based on the project forecasts, management can therefore truly forecast the result of the company as well. The 30 % should not be confused with a profit target for new projects. Projects should always be priced using Target Pricing otherwise the company will risk failing in competitive bidding.

Table 5 – Hourly rates [NOK/hr] calculated based on demand adjusted for unused capacity based on maximum practical capacity in an ABC framework.

Expense centers	Indirect resource driver		Capacity Utilization	Total Indir. exp.	Absorbed costs	Direct cost centers: Engineering	Production	HSEQ	Project mgt
Project mgt	Direct attribution		90,0 %	2 300 000	2 070 000				2 070 000
Production	Direct attribution		70,2 %	34 610 000	24 297 633		24 297 633		
Engineering	Direct attribution		53,8 %	5 560 000	2 989 247	2 989 247			
Management & Sales	Number of hours	111 800	70,4 %	5 250 000	3 696 055	10 500	90 300	6 500	4 500
HSEQ	Direct attribution		81,3 %	5 000 000	4 062 500			4 062 500	
Finance	Indirect costs	37 115 435	70,4 %	2 000 000	1 408 021	3 336 372	27 282 908	4 277 387	2 218 768
Assigned expenses	13 %		70,4 %	7 250 000	5 104 076	3 346 872	27 373 208	4 283 887	2 223 268
Directly attributed expenses				47 470 000	33 419 380	2 989 247	24 297 633	4 062 500	2 070 000
Total expenses				**54 720 000**	**38 523 456**	**6 336 120**	**51 670 841**	**8 346 387**	**4 293 268**
Expense centers	**Indirect resource driver**			**Total Indir. exp.**	**Absorbed costs**	**Direct cost centers: Engineering**	**Production**	**HSEQ**	**Project mgt**
Cost pool direct attribution	Direct attribution			33 419 380	33 419 380	2 989 247	24 297 633	4 062 500	2 070 000
Management & Sales	Number of hours	3 696 055		3 696 055	3 696 055	347 125	2 985 275	214 887	148 768
Finance	Indirect costs	1 408 021		1 408 021	1 408 021	126 570	1 035 012	162 268	84 172
Assigned costs	13 %			5 104 076	5 104 076	473 695	4 020 287	377 155	232 940
Directly attributed costs				33 419 380	33 419 380	2 989 247	24 297 633	4 062 500	2 070 000
Total costs	**OK**			**38 523 456**	**38 523 456**	**3 462 942**	**28 317 920**	**4 439 655**	**2 302 940**
Calculated hourly rate	Cost of unused capacity		29,6 %	**16 196 544**	345	330	314	683	512

Based on these discussions, we accept the research hypothesis. We have demonstrated that an ABC model where capacity is modeled as in the adjusted CAM-I Capacity Model, is superior to other approaches both in terms of logic and also in terms of usefulness for business purposes. We can just imagine the increase in competitive bidding coming from using an hourly rate of 345 versus 549…

However, it comes with effort and at a cost. It requires a more sophisticated costing model and during project execution, the handling of large Variation Orders (VO) becomes critical because they will impact demand and hence unused capacity. It also requires that the company is capable of distinguishing GAAP from MAAP (Managerially Accepted Accounting Principles), see discussion in (Emblemsvåg and Cokins 2020) – this approach is not compliant with external reporting requirements in most places.

Some final thoughts are discussed next.

6.5 Discussion of approaches

When comparing the results of the approaches in **Table 6**, it is easy to argue that the extra finesse of the last approach added little value for the hourly cost rate estimate. The main advantage was a clear understanding of the cost of the idle capacity and hence provides additional decision support for managing idle capacity. For the projects, alternatives 3A and 3B will largely indistinguishable since the hourly cost rates will largely the same but stable in both cases. The most important is therefore to avoid the simplistic handling of capacity and demand illustrated by alternatives 1 and 2.

Table 6 – Comparison of hourly rate [NOK/hr] estimates from the different approaches.

Hourly rate for	Alt. 1	Alt. 2	Alt. 3A	Alt. 3B	Max - Min
Engineering	439	598	329	330	269
Production	553	447	313	314	240
HSEQ	703	847	683	683	165
Project mgt	585	579	511	512	74
Weighted average	**549**	**489**	**340**	**345**	**210**

This begets the question of whether using ABC was wasted effort or not. In this particular example, the benefits were relatively modest because the portion of expenses directly attributed to the direct cost centers was so high (87%). This depends on several factors and their impact on the amount of overhead costs. First, how the projects are organized compared to the company has a major impact. Projects with their own organization covering everything will benefit very little from using ABC because the amount of overhead costs coming from the central functions of the company will be low. This applies certainly to the construction industry where heavy machinery, subcontractors and everything is dedicated to a specific project and essentially becoming direct costs.

Second, the amount of overhead costs in the company where the projects share a large portion of the resources is critical – a situation typically found in shipbuilding and fabrication. If the company has many manual work centers and a modest organizational structure, the case will be as in the example: a modest amount of overhead costs rendering the difference relatively small with or without ABC. However, in advanced companies with expensive work centers and/or with significant organizational structures the benefits of using ABC will be very real. Thus, the value of improved decision-support must be weighed against the costs of obtaining this improved decision-support.

It all starts, however, with being able to estimate the costs correctly and then make a decision as to what to do with the insight it offers.

7 Some issues concerning subcontracting and how to handle it

Throughout this paper, we have used the term ‘subcontracting’ as if subcontractors are a homogeneous lot. They are not. However, with a correct calculation of the hourly cost rates, we can make informed decisions about a variety of issues project-based industries grapple with including subcontracting. Typically, there are two contractual arrangements that gives two different approaches.

First, the subcontractors' clock hours and the corporation pays according to the number of hours and the agreed hourly rate. In this case, we must add the proportion of the overhead costs of the hourly cost rate to the agreed hourly rate of the subcontractors to arrive at the true hourly cost rate of the subcontractors. In so doing, we assume the same absorption of overhead costs between own employees and subcontractors. On site-based production such as in Shipbuilding, this is not unreasonable. However, once we have a system as advocated in this series of papers, this is straightforward. Typically, we will find that the subcontractors are more expensive than the employees of the corporation. Thus, using subcontractors can not be argued from a cost perspective but rather flexibility and competence.

Second, the subcontractors have a fixed-price contract. In this case, the corporation typically only knows the contractual lumps sum for the agreed scope of work, the duration and the number of workers per day or per week. The latter is important also for safety- and access issues.

In terms of cost accounting, such contracts are often handled as procured items. Yet, the same people often require the usage of the facility, support functions and the like. Treating such subcontractors as procured items, therefore, fail to acknowledge that they demand overhead resources. This makes fixed-price contracts appear more cost-effective than they are. Hence, this must be corrected in the project cost. One way of doing this is to assume the same overhead hourly cost rate as the other people, multiply by the guesstimated[3] number of hours, then establish a likely absorption of overhead costs and add that to the fixed price contract. As the project progresses, then the physical progress can be used to estimate the amount of overhead resources used for a given accounting period.

In this way, we see from the discussions that we can accept the research hypothesis and claim that we have found a better approach. The calculation of hourly cost rates using ABC and a revised I-CAM Capacity Model enables corporations to correctly estimate the hourly cost rates, and this is highly relevant

[3] Keep in mind that for fixed-price subcontractors the number of hours is often a business secret that they do not want to share.

to project-based industries. This said, it is important to think through the realities critically before using the hourly cost rates in decision-making concerning subcontracting and the like – context is king.

8 CLOSURE

Due to the capabilities of reducing costs and increasing the overall resource efficiency, ABC had been used in more and more areas as shown in **Figure 3**. The increase in applicability has expanded continuously, and in this paper, an even newer approach has been shown – ABC in calculating hourly cost rates for projects. Unfortunately, ABC has been oversold by consultants and academics because it has been applied indiscriminately and without insight into what level of value it adds compared to the implementation complexities. See the provoking paper where (Johnson 1992) attacks the activity-based 'panaceas'.

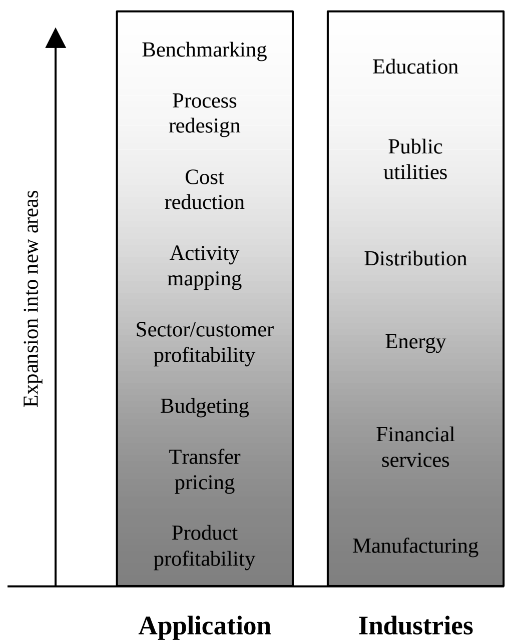

Figure 3 - The increasing areas of ABC application in early years. Source: (Morrow and Ashworth 1994).

Therefore, to be correct, the merit of using ABC is strongly correlated with the amount of overhead costs relative to direct costs. Its primary use is for providing strategic profit margin analysis with much higher cost accuracy and visibility, useful for pricing, for understanding what causes (i.e., drives) costs and focusing on operational cost reduction and management opportunities associated with lean and quality management. But it also adds value in the relatively simple case in this paper. It provides an intuitive structure that facilitates understanding at minimal extra effort provided that simplicity is maintained.

Again, simplicity versus accuracy is an important criteria when designing cost management systems, see (Cokins 1996). However, there should be no doubt that in most cases the single most important aspect of correctly calculating the hourly cost rates is through correct handling of capacity as facilitated for project-based industries by the revised CAM-I capacity model.

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