



Systematic approach to activity based costing of the production planning activity in the book manufacturing industry

Costing of the production planning activity

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Abstract *This paper justifies the need for moving indirect production planning costing in the book manufacturing industry toward direct production planning costing. Principles of activity based costing are utilized to accomplish this feat. This paper develops a methodology to break down the various tasks required in planning a job for production in the book manufacturing industry and to apply time measurement to these activities. These time measurements can then be used to individually cost the planning process of any book manufacturing company. The methodology is tested and justified through extensive data collection and application in a major book manufacturing firm. Thus, this industry can now effectively apply cost to activities of the planning process for each individual job as a direct cost, rather than an indirect one.*

Introduction

In book manufacturing, just as in any other business, there are many jobs that are not directly related to the manufacturing of the product. There are jobs related to human resources, customer services, billing, information systems, maintenance, accounting and payroll that are typically referred to as "front office" positions.

However, in the business of manufacturing books, there is a job description that tends to be grouped with these other "front office" positions. These are the jobs of the production planning or the book engineering department that is intricately involved in the successful manufacturing of the actual book. The efficiency of this department is often difficult to calculate because their job tasks vary from day to day, and even order by order. This department is a very integral part of the organization and, though its jobs are not hands-on at the press or in the bindery, it has a direct responsibility for every step being done correctly all the way down the production line. Its job is to provide detailed instructions of the production process on all printing orders from the time they are picked up from the backlog shelf to the time the books are shipped to the customer.



The planning job entails interpreting specifications from the information provided by the customer, and converting them into technical specifications for all internal departments. This is a very detailed process because it involves addressing any problems that may be foreseen and finding a solution before the order is placed into production. Just to create a basis for this study, let us examine the most standard type of order while keeping in mind the similarities and differences or constants and non-constants as they become apparent. While going through the steps from beginning to end, try to envision the activities involved in the planning process. This will be important when attempting to define some sort of standard timing factor to apply to the key tasks in similar jobs. A typical routine job requires many steps and a fair amount of detail to ensure that the customer receives the book the way it was described. The required customer specifications are as follows:

- title and author of the book;
- number of pages;
- binding style,
 - if case bound – the cloth cover specs and type of foil stamping to use are needed
 - if paperback – the cover mech. and ink colors are needed;
- type of paper stock to be used;
- color of text ink;
- final quantity;
- copy to image from (camera or disk);
- shipping instructions.

These are the main ingredients needed for the planner to proceed. If any of these are missing, questions will arise immediately.

Traditional and proposed method of costing

Most companies in the book manufacturing industry apply the cost of the planning process to overhead because they find it difficult to factor out various processes within the job. A formula that is often used is to take a percentage of actual production cost on the shopfloor and material cost associated with this function:

$$\text{Planning cost} = (\%)(\text{production labor cost} + \text{material cost}) \quad (1)$$

Thus, the time consumed in planning and preparing a job for production is not always costed at a fair price to the individual customer or to the company: the planning cost for a simple job with a long production run is often over-estimated, while the planning cost for a difficult job with lots of detail and art work with a small production run is often under-estimated.



As business becomes increasingly competitive in this age of technology, companies are becoming more skeptical about the accuracy of their cost and bidding systems. A common complaint is that the costing system does not produce numbers that reflect the way various products differ in their use of planning resources. It has become apparent in manufacturing that the more you are able to apply as direct cost to each job and subtract from your indirect cost percentage the more competitive you can be.

Companies in book manufacturing, however, do recognize the following distinct cost pools:

- direct cost category:
 - material cost;
- indirect cost pools:
 - utilities cost
 - space cost
 - technology cost
 - labor cost.

This paper presents the methodology for moving to activity based costing in the planning phase of the book manufacturing industry, while using above cost pools. It also justifies this methodology as it is applied to book planning at Thomson/Shore.

Methodology

When moving toward activity based costing, the following general approach is suggested:

- identify the job that is the chosen cost objective;
- identify the present direct cost categories for the job;
- identify the present indirect cost pools associated with the job;
- select a cost allocation base to use in assigning each indirect cost pool to the job;
- develop the rate per unit.

The book planning job of any production size is the cost objective of this research. All activities that possibly constitute this job are listed in Table I. Repetitive tasks are tasks that are done for all book planning jobs, while non-repetitive tasks are additional tasks that need to be performed on some jobs.

Too often the only direct cost category for the book planning function is direct materials cost. This represents a very small fraction of the total planning cost.



	Work content	Type	*
1	Picks up a job from backlog shelf	Repetitive	C
2	Put initials into smart screen to let people know who is working on job	Repetitive	C
3	Pull a customer card (gives detailed information about the existing customer)	Repetitive	C
4	Enters customer number, date of job arrival and binding style into computer job order	Repetitive	C
5	Punches into job in real time (this step cannot be done until the previous step is complete)	Repetitive	C
6	Reads paper work on the job (i.e. customer card, quotes, instructions from customer)	Repetitive	C
7	Go through customer furnished text copy	Repetitive	V
8	Size halftones or line art that go in copy	Non-repetitive	V
9	Go through insert section (section of book that prints on a different stock from the text)	Non-repetitive	V
10	Determine page count	Repetitive	C
11	Count halftones and/or strip-ins and package in 50s	Non-repetitive	V
12	Figure print surface and the margins for the text	Repetitive	C
13	Prepare and print the imposition for the layout department to lay signatures to	Repetitive	C
14	Go through covering materials for the book	Non-Repetitive	V
15	Figure the bulk of the book	Repetitive	C
16	Print diagrams for the cover and/or jacket	Repetitive	C
17	Check to see if the stamping for the case will fit	Non-repetitive	C
18	Fill out the stamping neg. request form	Non-repetitive	C
19	Fill out the furn. neg. request form	Non-repetitive	C
20	Enter all information for the job into the computer job order	Repetitive	C
21	Enter the shipping instruction into the computer ship screen	Repetitive	C
22	Enter any items still to come from the customer into the items-to-come screen	Non-repetitive	C
23	Address any problems or questions pertaining to the job w/customer service rep	Non-repetitive	C
24	Revise job order with answers received from the customer service rep.	Non-repetitive	C
25	Type blues letters, any POs needed, file label and job order envelope	Repetitive	C
26	Make copies for the perspective packages that must be distributed	Repetitive	C
27	Distribute packages to the proper places	Repetitive	C
28	Put completion date into smart screen to let people know what day the job order was completed	Repetitive	C
29	Punch out of job in real time	Repetitive	C

Table I.
A typical book
planning key task list

Note: * C stands for constant time; V stands for variable time

Present indirect cost pools are: utilities cost, space cost, technology cost and the labor cost that goes into the planning activity. As indicated in the introduction these are often costed as a percentage of book manufacturing and material cost. Technology cost represents the capital cost of computer systems, hardware and software. The planners, in performing their planning activities, solely use these systems. The labor cost relates to the time the planners spend on each book project preparing the technical specifications for the book manufacturing department and the shipping department.

The cost allocation base to be used in assigning each of the cost pools to the job of book planning is the actual and reasonable time spent on the planning job. This time, combined with the average labor cost, technological cost, utilities and space cost per unit time, constitutes the cost of the planning job.

$(\text{Planning cost})_i = (\text{Estimated planning time})_i \text{ Planning cost rate}$ for every i

$$\text{Planning cost} = (\text{Est. planning time})(\text{Labor cost} + \text{Tech. cost} + \text{Utilities cost} + \text{Space cost}) \quad (2)$$

Detailed work measurement analysis will result in establishing constant time components and parameters for variable time components of tasks that make up various book planning jobs. A three-step approach is suggested to accomplish this:

- (1) detailed evaluation of key tasks;
- (2) grouping of key tasks;
- (3) determination of time values for key tasks.

Detailed evaluation of key tasks

Before any data can be evaluated for the purpose of time measurements, a detailed key task list of all the planning jobs has to be prepared. This requires the cooperation of upper management in allowing the time to perform such a feat. It is done by first listing all the duties and responsibilities of this function. Then all the key tasks involved in the majority of the jobs processed are listed in a random order and presented to the planners. Each planner now denotes the chronological order that they follow when processing a job. This results in a typical list of key tasks as shown in Table I. Each key task is then further broken down into a detailed task analysis. This analysis for all 29 key tasks of Table I can easily cover a dozen pages of information. The list below is a sample of a key task analysis for key task number 6, "Read paper work on a job".

- (1) Read customer's paper work (letters, purchase orders, etc.).
- (2) Read the entire customer card.



- (3) Read entire story sheet.
- (4) Read quote. Question all information that differs from customer letter or PO.
- (5) Read all requests for quote information.
- (6) Read the electronic pre-press works (if it is a disk job). Make sure all questions have been answered.
- (7) If reprint, read order from previous printing:
 - pull old assembly sheet and write new job number on it;
 - pull old impositions and write new job number on it;
 - on the assembly sheet write “new” next to every page that is being replaced;
 - pull all old POs reworks and anything that may need to be pulled forward for this printing;
 - put red line across the old job envelope and the job order and update to new job number.

This task analysis aids in the process of computing time standards for some key tasks. It also aids in clearly determining the beginning and the end of key tasks.

Grouping key tasks

After determining a common sequence of key tasks, the tasks are assigned to groups. The first group (Group I) consists of the time it takes for the planner to physically retrieve the job and ends when the planner actually starts to work on the job. These are the tasks 1 through 5 in Table I. All these tasks are done each time a book is planned. They are therefore called repetitive tasks. The second group (Group II) starts when the planner begins to go through the copy (i.e. works on the job) and ends when the planner completes the job. These are tasks 6 through 24. Some of these jobs are done for all books. These repetitive tasks are task numbers 6, 7, 10, 12, 13, 15, 16, 20, and 21. Other non-repetitive tasks are tasks that are performed on some of the jobs. These are task numbers 8, 9, 11, 14, 17, 18, 19, 22, 23, and 24.

Finally, the last group (Group III) consists of five repetitive tasks that relate to packaging the job and sending it into production.

Determining time values through direct work measurement analysis

In order to be successful in categorizing and measuring any labor functions, the accuracy and the amount of data are very critical. The approach to setting standards for constant time components and for parameters of variable time components is based on data that have been collected over a six-month period



for over 500 planning jobs at Thomson/Shore Book Manufacturing in Dexter, MI. Detailed data on all 500 planning jobs were entered into the computer. These data included all characteristics of the product:

- type of job (i.e. camera copy, on disk or furnished negatives);
- number of pages in the book;
- number of photos or illustrations to be placed in the book (if applicable);
- insert and tip-in function (if applicable);
- the cover or jacket materials requested on each job;
- any extra detail work required by the planner;
- if the job will be paperback, case bound or split (meaning both).

In addition to the characteristics of the book, work measurement data were collected for each job as follows.

Group I and Group III key tasks were measured as a group. These key tasks are all constant repetitive tasks, reflecting minimum variation from one job to another job. The average work measurement times observed for these tasks, giving reasonable allowances for unavoidable delays, are:

$$T_I = 12 \text{ minutes} = 0.20\text{hrs} \quad T_{III} = 15 \text{ minutes} = 0.25\text{hrs}$$

The second group of tasks consists of both repetitive and non-repetitive tasks. Each of these tasks was measured separately. For this group a task analysis was very useful, because it made it easier to determine when each task began and ended. Data analysis for these tasks resulted in the following conclusions and work times:

Key task no. 6: reading paper work on the job.

The work measurement time for the repetitive constant task no. 6 was observed to be six minutes.

$$T_6 = 6 \text{ minutes} = 0.10 \text{ hrs}$$

Key task no. 7: go through customer furnished text copy.

The repetitive constant tasks 10, 12, 13, 15, 16, 20, and 21 are performed while going through the customer's finished text copy (key task no. 7).

The times recorded for these elements reveal that the total time is a function of the number of pages. This was consistent for all 500 jobs evaluated. Therefore, the unit time per page can be used to estimate this job. The page parameter time was determined through work measurement analysis and set at 0.007192 hours per page. Therefore the time for key task no. 7 (including key tasks nos 10, 12, 13, 15, 16, 20 and 21) in hours is:

$$T_7 = 0.007192(x) \text{ number of pages in book}$$

Key tasks no. 8 and no. 11: Size halftones or line art that go into copy and count halftones and/or strip-ins and package in 50s.



Data collected on these two elements demonstrate that the time depends on the number of halftones and the total time is linearly related to that number. Therefore, a time per halftone can be determined and used to estimate the job time. The halftones parameter time was determined through work measurement analysis and set at 0.0383 hours per halftone. Therefore, the time for key task nos 8 and 11 is:

$$T_{8,11} = 0.0383 \times \text{number of halftones in book}$$

Key task no. 9: Go through the insert section.

As for the previous non-repetitive variable key tasks, the time of this task depends on the number of inserts going into the book. Work measurement analysis revealed a parameter time of 0.25 hours per insert. Therefore, the time for key task no. 9 is determined as follows:

$$T_9 = 0.25 \times \text{number of inserts (an insert consists of 8 pages)}$$

Key task no. 14: Go through covering materials for the book.

A book might need a cover or a jacket or both. The time measurement for key task no. 14 depends on the number of items that need to be attended to for the book. According to the data collected there does not seem to be a significant difference in time whether a jacket or cover needs to be considered. If both are necessary, then it will take twice as long. Based on work measurement data, the unit parameter time for this task is set at 0.2 hours per item. Therefore, the total time per book is calculated as follows:

$$T_{14} = 0.2 \times \text{number of items (cover, jacket, or both)}$$

Key tasks nos 17, 8 and 19: Filing out die art request.

Some jobs may have neither a cover nor a jacket and if this is the case, then key tasks 17, 18, and 19 need to be done. In some cases the hard cover or case bound book will have a jacket and stamping art where key task nos 14, 17, 18, and 19 need to be performed. In any case, when key tasks 17,18, and 19 are done, the average work measurement time observed for these tasks, giving reasonable allowances for unavoidable delays, is:

$$T_{17,18,19} = 6 \text{ minutes} = 0.07 \text{ hours}$$

The total time per job can now be estimated before a book is planned if all these characteristics of a job are entered into the database that consists of above work measurement constants and parameters. This will allow the planning department to schedule and cost the book planning activities more accurately and competitively.

Therefore, the formula for calculating the estimated total time for processing a job is:

$$\text{Total time} = T_I + T_{II} + T_{III}; \quad T_{II} = T_6 + T_7 + T_{8,11} + T_9 + T_{17,18,19} + T_{14}$$



Verification of methodology

The chart shown in Table II consists of 32 randomly selected jobs at Thomson/Shore over a three-day period.

This is a simplified version just to get an idea of the program's functions. The times noted here are based on hours. In column 1 is the job number. Column 2 lists the page counts for the text of each book. Column 3 represents the quantity of halftones in the job, shown as the time allotted for each halftone. Column 4 is stating the number of inserts in a job. This too requires added time in the planning process due to the degree of difficulty it can cause while placing it in the proper place of the text. In column 5 (number of coverings) the number indicates if the job has a cover or jacket that we are to print with the job. A no. 1 equals either "a cover or a jacket" and a no. 2 means that we are printing both. This needs to be known so that additional time can be allocated for the extra processes needed in preparing these items. The time for this process is 0.2hr or 12 minutes per covering required. Column 6 represents the time required for sizing and calculating the case stamping. This time was calculated to be 0.07 hours or four minutes. Again, this is just an average depending on the degree of difficulty in the stamping art. As mentioned, this function needs to be calculated only if there is a hard cover book that requires it. Column 7 is the time allowed for the tasks in both groups one and three.

As the data demonstrate, in comparing just these 32 samples, the difference in total time is very minimal (1.21 hours in the company's favor). It should also be noted that the mean error or bias is -0.038 . This indicates that there is a bias and the time was overforecast by an average of 0.38 or 2.3 minutes per job for the 32 randomly selected jobs. We also need to be concerned with the error's magnitude. Note for the example in Table II, we obtain a mean absolute deviation, MAD, of 0.84. The MAD expresses the size of the average error irrespective of whether it is positive or negative. It is the combination of bias and MAD that allows us to judge the results. When we divide the bias by the MAD we get a tracking signal of -0.068 . If the forecast is unbiased, the tracking signal will be near zero. For important items such as this analysis, an indicator of 0.03 or 0.04 would be acceptable. Our tracking signal can be improved by collecting a larger sample. However, demonstrating a new method of costing to this company has shown Thomson/Shore that this idea of costing out the process of planning is not just a fantasized idea but a factual reality.

Benefits of accurate ABC costing for the book planning function

The major benefit for establishing accurate costing for the planning function in book manufacturing is that the company now can estimate the real planning cost for any customer's job. Thus the company is able to correctly bid on any customer's job. To illustrate the accuracy and the impact of this ABC approach



Table II.
32 randomly selected
jobs estimated

Job no.	No. of pages $T_7 = 0.007192$	No. of HT $T_{8,11} = 0.0383$	No. of insert $T_9 = 0.25$	No. of covering $T_{14} = 0.2$	Stamping $T_{17,18,19} = 0.07$	Total time $T_1 = T_6 + T_{III}$	Est. time	Actual time	DIFF.	ABS
1	344	0		0	1	0.55	3.09	2.46	-0.63	0.63
2	272	45	1	2	1	0.55	4.95	5.62	0.67	0.67
3	376	0		0	1	0.55	3.32	2.36	-0.96	0.96
4	472	12		0	1	0.55	4.47	3.42	-1.05	1.05
5	120	7		0	1	0.55	1.75	1.75	0.00	0.00
6	216			1		0.55	2.30	1.36	-0.94	0.94
7	232	1		0	1	0.55	2.33	3.26	0.93	0.93
8	264	4		1		0.55	2.80	3.88	1.08	1.08
9	568			0	1	0.55	4.71	7.7	2.99	2.99
10	120	4		1		0.55	1.77	2.77	1.00	1.00
11	256	7		1		0.55	2.86	4.46	1.60	1.60
12	336	47	1	0	1	0.55	5.09	5.02	-0.07	0.07
13	464	39		1		0.55	5.58	4.45	-1.13	1.13
14	272	29		1		0.55	3.82	3.34	-0.48	0.48
15	128			1		0.55	1.67	1.85	0.18	0.18
16	296	41		1		0.55	4.45	4.46	0.01	0.01
17	232		3	1		0.55	3.17	3.4	0.23	0.23
18	96			1		0.55	1.44	3.64	2.20	2.20
19	176			1		0.55	2.02	1.2	-0.82	0.82
20	168			1		0.55	1.96	2.12	0.16	0.16
21	144			1		0.55	1.79	2.87	1.08	1.08
22	112			1		0.55	1.56	1.72	0.16	0.16
23	304			0	1	0.55	2.81	2.08	-0.73	0.73
24	408	12		0	1	0.55	4.01	1.25	-2.76	2.76
25	296	8		0	1	0.55	3.06	2.39	-0.67	0.67
26	280	157	1	1		0.55	9.03	7.66	-1.37	1.37
27	256			2	1	0.55	2.86	2.71	-0.15	0.15
28	48	10		1		0.55	1.48	2.14	0.66	0.66
29	0	4		0	1	0.55	0.77	0.72	-0.05	0.05
30	216		0	1		0.55	2.30	2.21	-0.09	0.09
31	112		1	2	1	0.55	2.08	1.81	-0.27	0.27
32	320	57		1		0.55	5.23	3.22	-2.01	2.01
Total hours							100.51	99.30	-1.21	0.849
									-0.038	MAD
									BIAS	-0.068
									Tracking signal	



to costing, let us examine what difference it makes for Thomson/Shore, who previously costed the planning job as 2 percent of production cost. This is illustrated in the Appendix for job nos 18 and 26.

At Thomson/Shore the various cost pools are:

- labor cost: \$10.5/hour;
- technical cost: \$17.00/hour (computer, calculator, Xerox machine and light table);
- utilities cost: \$8.00/hour;
- supplies cost: \$2.50/hour;
- space cost: \$6.00/hour/cubic;

This represents a total cost of \$44.00 per hour.

The planning cost for job no. 18 is over-estimated by a factor of 3.5 under the old method. While the planning cost is only \$63.36, the customer will be charged \$226.88 under the old method. However, note that for job no. 26 the customer is under-charged by a factor of 3.7. This costs the company \$290.25.

A secondary benefit is that the time standards can be used to monitor the productivity of the planners. This productivity can then be considered in future promotions and advancements.

Conclusion

“Production planning” or “book engineering”, for the majority of the printers in the USA, has been a nagging overhead cost to the corporate structure since the start of the industry. Even though the tools used in designing the final product have made the job easier to manage, the time in processing has still been a difficult thing to predict. With the onset of all this new technology, though, there will be a need to cost out these types of indirect labor functions. The authors of this research believe that the analysis in this paper will be the beginning of a new era in estimating the cost of jobs for other planning processes.

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Appendix. Comparative cost analysis

Old method

**Planning cost: 2% of production:
Data:**

1 plate: \$10.20 (1 plate per 32 pages)
 1 sheet: \$0.3060 (1 sheet per 32 pages)
 1 halftone: \$10.00
 Binding cost: \$2.04 per copy
 Folding cost: \$0.051 per sheet
 Press cost: \$0.12 per sheet
 Covering cost: \$150 per color
 Plus \$0.15 per copy

Job #18

	Cost
3,000 copies	3 plates: \$30.60
96 pages	9,000 sheets \$2,754
no halftones	binding cost \$6,120
3 color cover	folding cost \$459
	press cost \$1,080
	<u>covering \$900</u>
	\$11,344
	× 2%
	\$226.88

Job #26

	Cost
500 copies	9 plates: \$91.80
280 pages	4,500 sheets \$1,377
157 halftones	binding cost \$1,020
3 color cover	folding cost \$229.50
	157 halftones \$1,570
	press cost \$540
	<u>covering cost \$525</u>
	\$5,353.30
	× 2%
	\$107.07

New method

**Planning cost: ABC estimates:
Data:**

Unit cost for all cost elements:
 (technology, utilities, space and labor)
 \$44/hour

Job #18

Cost
\$44.00 per hour
× 1.44 hours
\$63.36

Difference of \$163.52; loss to customer

Job #26

Cost
\$44.00 per hour
× <u>9.03 hours</u>
\$397.32

Difference of \$290.25; loss to company



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