Course-Level Activity-Based Costing as an Academic and Financial Tool

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About this Research

This paper is one of five in the *TIAA Institute Higher Education Series: Understanding Academic Productivity*, an initiative undertaken in support of NACUBO's Economic Models Project. That project was launched by NACUBO with the aim to provide colleges and universities with knowledge, ideas and tools to advance the difficult structural, cultural and political changes required for moving to more sustainable economic models. Given NACUBO's goal of offering thoughtful, objective and credible scholarship on the issues at hand, the TIAA Institute was a natural partner for the project.

This paper, written by William Massy, former Vice President for Business and Finance (among other senior positions) and emeritus professor at Stanford University, offers an in-depth description of an enhanced Activity-Based Costing (ABC) tool by way of a case study of its implementation at the University of California – Riverside. Massy notes the partnership between the provost and CFO there as critical to the success and ongoing refinement of the project, and shares key information to help senior campus leaders assess the value of the enhanced ABC tool for their institutions.

About the TIAA Institute

The TIAA Institute helps advance the ways individuals and institutions plan for financial security and organizational effectiveness. The Institute conducts in-depth research, provides access to a network of thought leaders and enables those it serves to anticipate trends, plan future strategies and maximize opportunities for success. To learn more, visit www.tiaainstitute.org.

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NACUBO, founded in 1962, is a nonprofit professional organization representing chief administrative and financial officers at more than 2,100 colleges and universities across the country. NACUBO's mission is to advance the economic viability, business practices and support for higher education institutions in fulfillment of their missions. For more information, visit www.nacubo.org.

Executive Summary

Delivery of quality education in a budget-constrained environment requires that academic and financial decision-makers understand the activities, costs and margins associated with teaching at the course level. Working in partnership, the provost and CFO at the University of California - Riverside (UCR) have implemented an "enhanced Activity-Based Costing (ABC) tool" to supply this information.[1] The tool integrates data from the university's enterprise systems with survey responses from faculty and/or department chairs to estimate, for each course in the curriculum, teaching activity profiles, resource utilization and financial outcomes, and rough quality surrogates. Short-term benefits include assessing resource allocation strategies and prioritizing budget alternatives, quantifying the levels of cross-subsidization across the institution, gaining deeper insights about course redesign, and improving human resource and facilities utilization. Longer term, the goal is to transform how departments think about optimizing cost in relation to resource utilization and education quality. This essay discusses the reasons for developing the model, outlines its conceptual structure, illustrates the kinds of information it provides, and describes some ways it will be used in academic planning and decision-making.

This paper is one in a series of five focusing on productivity and new economic models for higher education.

The series offers a deeply-informed review of the literature, a two-part examination of higher education's contributions to the public good, an assessment of state-level efforts to measure productivity, and an in-depth description of a course-based tool to analyze costs.

Key Takeaways

- While course content remains paramount for faculty, achieving the university's mission in today's world also requires attention to teaching processes, costs and margins.
- Faculty and other academics should be provided with the tools and knowhow needed for assessing the trade-offs between cost and quality, and the efficacy of cross-subsidies among courses and departments, because administrators themselves cannot do that job effectively.
- The development of such tools was not possible until recent advances in university enterprise systems (especially timetabling and student registration systems), and now only modest supplementary data need be generated by survey.
- The familiar aggregate metrics for assessing teaching "productivity" (such as cost per credit hour) for courses, departments, degree programs, etc., are readily calculated from the enhanced ABC tool, but in a way that helps faculty improve their offerings rather than focusing on accountability and risking a "race to the bottom" in terms of quality.
- To be successful, the deployment of such tools requires active championing by academic leaders (in UCR's case, the provost) as well as financial officers.

1. The author wishes to acknowledge the contributions of Paul D'Anieri and Maria Anguiano, the provost and CFO, respectively, at the University of California-Riverside (UCR). Implementation of the enhanced ABC tool at UCR would not have been possible without their partnership and commitment to this effort.

A growing California student population worthy of a top-flight university education in an era of reduced state funding made it an imperative for the University of California - Riverside (UCR) to better understand its costs in order to effectively scale student instruction. The provost and CFO at the University of California - Riverside joined forces to implement an enhanced Activity-Based Costing (ABC) model and software tool that provides detailed revenue and cost data at the course level. The tool reports the activities, costs, and revenues associated with the course portfolio and other university functions, which gives both academic and financial decision-makers better insight into their planning and budgeting options. For example, chairs and deans can do better in choosing the most appropriate mix of instructional models given their resource constraints, and demonstrate the efficacy of their choices. These objectives follow the spirit of the TIAA Institute's recent paper on how better data can improve institutional decision-making [Soares, Steele, and Wayt, 2016].

Activity-Based Costing (ABC) at the level of individual courses is the only approach that appears capable of meeting these objectives. It can address questions like: *What is the best way to deploy resources (people and funding) to achieve our educational mission? What is the best way to achieve any given curriculum within resource constraints? Could a different allocation of resources achieve better results with the same investment of time and money?* However, answering such questions effectively requires certain extensions to the normal ABC methodology, hence the term "enhanced ABC."

This essay describes the enhanced Activity-Based Costing (ABC) model and its benefits.

The model gives both academic and financial decision-makers better insight into their planning and budgeting options.

The co-authors have researched and written about this kind of ABC [Anguiano, 2013; Massy, 2016a, 2016b], and Massy has been working with the Pilbara Group, the pioneer course-level ABC software vendor in Australia. We viewed the project as an opportunity to put our ideas into practice in a real and important setting. In addition, a grant from the Bill and Melinda Gates Foundation is helping UCR to disseminate its results, and to implement enhanced ABC at the Johnson County Community College (Kansas).

This essay describes the model and its benefits, and presents preliminary results for a few sample departments. The university's other departments will be analyzed in due course.

Why this Kind of Project?

While academics routinely strive to improve the content presented in their courses, they often are content with the traditional configurations of lectures, discussion sections, laboratories, seminars, and so on. This view may have been justified in the past, when money was fairly plentiful, improvement opportunities were limited, and disruptive innovators like MOOCs and for-profit providers were not crashing the Academy's gates. The combination of budget factors that have undercut traditional models and technological changes that enable new models force leaders to examine different modes of instruction.

Enhanced Activity-Based Costing is the foundation required for traditional campuses to seize these opportunities to rethink and reconfigure standard models of instruction to best deploy resources (people and funding) to achieve their educational mission.

A few examples illustrate the kinds of decisions ABC can support:

- How much will it cost to adopt a new instructional model for an existing course, such as active learning in an introductory science class, or to add a new course such as a senior seminar to an existing curriculum? What changes to existing offerings and formats would be needed to free up enough resources to make such an adoption revenue neutral?
- If we want to increase enrollment in a relatively expensive major (i.e., one that requires subsidy), how much do we need to increase enrollment in a relatively inexpensive one (e.g., one that produces a surplus) to keep the budget in balance?
- If we need to boost overall enrollment, what are the options for increasing offerings within the increased tuition that will be generated?

To summarize, and this is an essential point, the goal of ABC is not simply to reduce costs, which we already know how to do. Rather, acknowledging that all of our decisions are made under cost constraint, the goal is to gather and use information about costs that allows us to maximize the quality we get for any level of spending.

The goal of ABC is not simply to reduce costs; **it is to gather and use information about costs to maximize quality for any level of spending.**

Course redesign, which has proved its worth in many fields and institutions [NRC, Appendix B], provides a strong precedent for the kinds of work needed. It demonstrates that learning can, in fact, be made more cost-effective. It also shows the importance of measurement. Comparing the learning outcomes and costs of proposed redesigns with those of courses as they are currently taught is an essential part of the process. Faculty have demonstrated their ability to design outcome assessments that involve pre-and post-tests on high-priority learning goals—including, where necessary, qualitative analysis using common rubrics. Other available indicators include course-completion and pass rates, better student attitudes toward the subject matter, increased student performance in downstream courses, and increased satisfaction with the mode of instruction. Course redesigners also learn to parse teaching-associated activities into bite-sized pieces and, with the help of cost accountants, determine the amount spent on each piece. This is a type of ABC. UCR's enhanced ABC tool automates this process and extends it from the realm of a single course to all courses across the campus.

The course redesign experience shows that campus-wide efforts to measure the quality and cost of teaching can be successful with, and only with, active faculty participation—yet this is hard to achieve on a broad scale. The so-called "student learning assessment movement" of the 1980s, which consisted of top-down initiatives imposed by states or senior administrators, was unsuccessful because it could not gain traction with faculty. As noted above, however, assessments initiated by faculty as part of course redesign generally are regarded as successful. The same is true of teaching cost: the collaborations between faculty and cost accounting professionals that characterize course redesign generally produce good results, whereas centralized top-down accounting methods usually fail to generate data that are helpful for improvement. One of UCR's major goals in this project is to design a tool that will engage significant numbers of faculty on a sustained basis.

UCR's Activity and Cost Tool

High-quality data for costs and activities needed for a complete ABC model requires an unusual partnership between the provost and CFO.

A complete ABC model relies on high-quality data for costs and activities. To obtain this data required a commitment from the joint partnership between the provost and CFO, which is unusual in a number of respects. Academic leaders rarely get involved with cost analysis at a deep level. They usually leave such matters to financial people, but this perpetuates the disconnect in higher education between quality and cost. If the financial model is to serve the academic mission, rather than the other way around (as many fear), then academic leaders must be deeply involved in setting up the financial model.

Utilizing a joint task force of administrators, faculty, and consultants, UCR's ABC implementation consisted of four broad implementation steps:

1. Integrating data from UCR's enterprise systems on course offerings, staffing, and enrollments and inputting it into ABC software
2. Estimating the direct costs of instruction (using timetabling, faculty time surveys, and unit costs of resources)
3. Allocating the indirect costs of instruction (e.g., administrative overhead and facilities costs)
4. Mapping activity data to cost data

Details on each of these steps are provided in the corresponding sections below.

The first objective was to build an information system for **integrating course level quality- and cost-related information.**

1. Integrating data from UCR's enterprise systems

The project's first objective was to build an information system for integrating course level quality- and cost-related information. The software implementation portion of UCR's ABC model was developed by the Pilbara Group and Grant Thorton LLP in six months. This implementation was expedited due to UCR's integrated data systems and prior work university staff, together with Deloitte consultants, had done during UCR's new budget process redesign.

Pilbara's Analytical Costing Engine (ACE), which is being used by more than a dozen Australian universities, lies at the core of the model. The innovation in UCR's implementation was enhancing the model's course data to include detailed information about multi-section courses (e.g., lectures with breakouts and/or labs) and the fine structure of teaching activities (course development, course management, teaching, tutoring, advising, and assessment/grading), which were not previously part of the model.

UCR's enhanced ABC tool combines data from the campus' transactional systems with business rules that describe how teaching activities are structured. The relevant systems are the general ledger, human resources, facilities management, and student registration and timetabling; in other words, just about everything that is captured by the university's computers. The data are loaded once a year, after which results are available online at any desired level of detail. Space allows us to describe the data and business rules only in general terms, but this is enough to provide a sense of the tool's reach and richness.

2. Estimating the direct costs of instruction

Data are captured for organizational units (e.g., departments), function codes (teaching, research, etc.), fund groups, and, where necessary, to individual revenue or expense accounts. As in most cost accounting models, allocation rules distribute revenue, personnel, non-personnel, and facilities costs into appropriate pools, which are further allocated to the final cost objectives of teaching, research, and public service. What's different about the enhanced ABC tool is how it treats the direct costs and revenues associated with teaching. Direct revenues are relatively easy, e.g., because tuition and fees are associated with students who, in turn, are associated with individual courses. On the other hand, our ABC cost data still require allocation because universities do not (appropriately, in our view) capture cost details at the point of usage. (Faculty don't keep time logs or requisition most teaching materials, supplies, and equipment items for specific purposes.) The challenge is to make these allocations at a level that is sufficiently detailed to allow academic decision-makers to understand what's happening on the ground and act accordingly.

Timetabling and Student Registration Data. What distinguishes the enhanced ABC tool is the use of timetabling data. This allows the cost allocations to be derived from the structure of each course's teaching activities as described below. (Earlier ABC applications used aggregate drivers like student enrollment or credit hour generation.) The timetabling data come from the university's transactional systems, upon which both students and faculty rely to plan their schedules. This eliminates the need for extensive faculty surveys, and mitigates concerns about course-level ABC that have been circulating in recent years [Hurlburt, Kirshstein, and Rossol-Allison, 2014]. Judgments about the un-timetabled elements of faculty workload still are required, but anchoring them in the timetabled data makes their collection feasible.

What distinguishes the enhanced ABC tool is the use of timetabling data, which eliminates the need for extensive faculty surveys and mitigates concerns about course-level ABC.

The box below describes how timetabling data enter the enhanced ABC tool. It applies to one instance of a large course, call it Biology 1, as taught in the face-to-face mode (as opposed to online or hybrid) during the spring quarter of 2015. Such tables are provided for every course in the curriculum, with each course having its own configuration of lectures, discussion sections, labs, etc.

Timetabling Data: Bio 1 Example

Name & Institution	Head Count	Class Type	No. of Sections		Mtgs. per wk.	Class Hours by Teacher Type					Room ID
			Total	Repeat		Total	Prof.	Lect.	Adj.	TA	
Bio 1 Group A	440	Lect.	1	0	2	30	30	0	0	0	xxx
		Disc.	15	8	1	150	0	0	0	150	yyy

- Name & Group: catalog name and group tag. A group collects all the sections associated with a given plenary; courses without breakouts have no tags.
- Head Count: number of student enrollments as of the census date
- Class Type: in this case "Lecture" and "Discussion"
- No. of Sections: Total number of sections, and the number of sections where the teacher's preparation is repeated (i.e., the person already is teaching a similar section this semester)
- Class Hours by Teacher Type: Total hours = in-class hours per week × number of sections × number of weeks in the semester (10). The four "Teacher Types" break these hours according to the job classification of the instructor listed in the timetable (the lecture is taught by a professor; all the discussion sections are taught by TAs).
- Room ID: the room number of the classroom where the section meets (the UCR facilities database provides room type and capacity information)

It is also important to approximate the time teachers spend on course-related activities by estimating "course workload profiles" for un-timetabled activities.

Faculty Workload Profiles. What remains is to approximate the time teachers spend on course-related activities not included in the timetable. This is accomplished by estimating "course workload profiles" for time spent on un-timetabled activities. The model can store three kinds of profiles for each course, section type, and teacher type:

- *Ratios to in-class hours:* e.g., preparation (there are separate ratios for initial and repeat preparations)
- *Ratios to enrollment:* e.g., assisting students and grading (there are separate ratios for these two tasks)
- *Fixed hours:* e.g., course development and improvement (allocated in proportion to teacher hours: across sections, and over quarters if done on an episodic basis)

Storage is arranged in a hierarchical fashion, with lower levels in the hierarchy inheriting from above unless an input for that level is provided. Each of the categories can be subdivided to accommodate detailed survey results of the kind referred to earlier, though this is not strictly necessary. "Contact" time estimates for online courses, which are not timetabled but often carry specific expectations for the amount of virtual interaction with students, can be used in lieu of timetabled data if desired.

The fractions of time regular faculty spend on teaching, research and public service represent another kind of workload profile. This is handled in a similar way, except that many institutions have policies (e.g., 40% time on teaching, 40% research, and 20% on service) that can be used as the default input. Lecturers and adjuncts are assumed to spend all their time on teaching-related tasks. Pilbara's experience in Australia shows that deans and department chairs can approximate these figures with acceptable accuracy; early results in this country seem to confirm that outcome. Of course the workload profile data should be as accurate as possible, but it's important to remember that the largest driver of resource usage is provided automatically by the timetabling system. One should apply the 80-20 rule and not consider detailed workload surveys to be a necessary condition for applying the enhanced ABC tool—although they certainly are useful if available.

The fractions of time regular faculty spend on teaching, research and public service represent another kind of workload profile.

Since one of the drivers of the model depends on faculty workload, to test the sensitivity of various faculty workload assumptions, UCR asked Deloitte to conduct in-depth faculty workload interviews in the five departments. This was a deeper dive than needed for the enhanced ABC tool, *per se*, but we felt it would add perspective for model development and be useful for other university objectives. The data are still being analyzed, but issues relating to the reliability of recall-based responses, profile heterogeneity, small sample sizes, and extrapolation to departments beyond the five would limit the survey's utility as a direct input to the model. The other objectives are beyond our scope here, so the survey will not be discussed further.

Applying estimates of unit costs. The last step is to determine the costs of the resources being used, i.e., the time of professors, lecturers, adjuncts, TAs, and the facilities required to teach the course. The model uses the following allocation procedure to allocate the relevant cost pools (obtained by conventional accounting methods) to the courses: (i) the timetabled and un-timetabled data are summed to get the total hours that each section type (for the given course) requires from each teacher type; (ii) the salaries and associated costs for the teacher types, net of the fractional FTEs designated for research, service, administration, etc., are accumulated into departmental "teaching cost pools"; and (iii) the cost pools (including the pools for different kinds of facilities) are allocated to courses and section types in proportion to hours utilized.

The last step is to determine costs of the resources being used.

Notice that this calculation does not require data on the length of the faculty workweek. Such data are difficult to obtain—indeed, the very concept of a professorial "workday" or "workweek" is likely to be fraught with controversy. However, comparing the data in step (i) against the department's teaching FTEs allows calculation of an implied average workweek, which can be used as a reality check for the input data. For example, calculated workweeks that are too long or too short to be credible mean the workload profiles should be revised.

The resulting figure represents the "total direct cost" of teaching the course. Direct revenues are assigned as noted earlier. This enables the calculation of net and gross margins based on the direct and loaded costs, respectively. Average direct and loaded cost per student, credit hour, and class section are easily calculated from the above. The effect of adding significant numbers of extra students can be approximated by using the figure for direct cost. A future version of the tool may include a better approximation for small changes in student numbers, where filling excess capacity in particular sections can be a factor.

Meaningful allocation of indirect costs of courses required developing cost categories important for financial purposes.

3. Allocating the indirect costs of instruction

Meaningful allocation of indirect costs to courses required UCR to create cost categories that were meaningful for financial purposes. These categories allow a high-level view of expenses and also the flexibility to analyze the specific activities within category groupings. Different costs have different cost drivers, so part of the effort included the development of business rules that determined how costs would be allocated among all units. Administrative organizations that do not bring revenue to the campus were lumped into "cost pools" and their expenditures were allocated to revenue generating units (colleges/schools and auxiliaries) as indirect costs. In order to distribute these expenses appropriately, the campus spent a substantial amount of time and effort deciding how to pool various administrative functions according to which revenue-generating units would pay for them, and how the costs would be allocated among those units. Determining these business rules was instrumental to ABC implementation. These rules were developed by UCR leadership after consultation with key campus stakeholders.

The juxtaposition of activity and financial variables in the enhanced ABC tool is designed to address legitimate faculty skepticism about detailed cost models for teaching.

4. Mapping activity data to cost data

The juxtaposition of activity and financial variables in UCR's enhanced ABC tool is designed to overcome the typical faculty skepticism about detailed cost models for teaching. Professors rightly worry that applying such models at the course level will bias decision-making toward financial rather than learning outcomes: for example, as in striving for low cost per credit hour, which can indicate high productivity or poor learning, weak research, or unsustainable workloads [Massy 2016, Figure 4.1]. This worry was shared by the National Research Council's Panel on the Measurement of Productivity and Higher Education, which warned that a single-minded emphasis on over-simplified "productivity" measures could trigger a "race to the bottom" as institutions search for the cheapest possible configurations of teaching activities.

This "curse of the cost data" is best mitigated by supplying *more* data, not less: that is, by providing detailed data about activities in juxtaposition with cost data. This forces consideration of things like class size and adjunct usage right along with cost, thus allowing academics to push back against proposed budget cuts when a good case can be made. The activity and cost variables used in the UCR tool are summarized in Chart 1, below.

The two kinds of variables are linked together by laws of arithmetic embodied in the "teaching production function." For example, fewer faculty means less cost, but also larger class sizes and more use of adjuncts. Massy [2016, p. 112] presents an example where a race to the bottom decimated the English department at a certain public flagship university to the point where large class sizes had made grading of serious writing assignments impractical, many exams were multiple choice, and the majority of classes were taught by adjuncts. These outcomes, which occurred gradually over the better part of a decade, might well have been avoided had data on quality-related activity variables been routinely available. We shall describe how the different kinds of variables can be used in the last section of this paper.

The "curse of the cost data" is best mitigated by supplying more data, not less.

Chart 1: Outputs Obtainable from the Enhanced ABC Tool

Activity Variables	Cost & Revenue Variables
Delivery mode (e.g., F2F, online, hybrid) and types of sections	Direct costs of teaching: total, per section, per student, per credit hour
Student headcount: in-state/out-of-state; student level (LD, UD, GR)	Direct revenue (e.g., tuition & fees): total, per section, per student, per credit hour
Numbers of primary and secondary sections, by type (e.g., lectures, labs)	Gross margin generated: total, per section, per student, per credit hour
Average class size by section type, and groupings of sections by size category	Full costs (i.e., including allocated overhead) and net margins
Personnel hours used, by kind of activity and teacher type	Costs, revenues, and gross margins for degree and certificate programs
Percent of room capacity utilized	Incremental direct costs for adding a certain number of students
Quality-Related Variables (Not available in Version 1.0, but there is a clear development path)	
Student attrition, grades and/or pass rates in this course and downstream	Faculty-generated learning measures as they become available

(All results pertain to individual courses, with roll-up to higher organizational units such as departments, schools, etc.)

The power of these ideas will be enhanced considerably when data on the "other quality-related variables" become available. Data on student attrition during the quarter may well be available within the registration system, and the same is true of grades. The student registration system tracks individual students through specific courses, which makes it possible to follow students downstream—perhaps all the way to graduation or withdrawal from the program. Hence it is possible in principle to relate the teaching activities and costs reported by enhanced ABC to downstream outcome variables.

The model's course-specific nature also lends itself to adding faculty-generated learning measures to the array of data that is presented in juxtaposition with cost. We noted earlier that course redesigners now collect such measures, and it's not too much to imagine this practice spreading as broader usage of the data becomes possible. The course redesign data often involve before-after measurements, so it may be possible to design other measures (e.g., percent changes) that allow comparisons among courses and fields.

The model's course-specific nature lends itself to **adding faculty-generated learning measures to the array of data presented, along with costs.**

Illustrative Results

Space permits us to show only a small sample of the results that are available from the enhanced ABC tool, but this is sufficient for purposes of illustration. Brief descriptions of the sample tables follow. [*The tables are at the end of the paper.*] The data are specific to departments and course levels unless otherwise noted. Similar tables are available for all courses at the university. Importantly, given the current stage of the implementation process, there has not been sufficient time for results to be fully vetted and reviewed. Therefore, we have masked the financial data by displacement with random variables. The changes are not so large as to obscure the basic orders of magnitude, but they should not be used to inform substantive discussions about the university.

1. *Enrollment; Cost, Revenue and Margin, per Student FTE*. This is the core table for conventional Activity-Based Costing. It shows the direct costs, revenues, and margins student FTE that were generated by the enrollments shown in the first column. Revenue in this case is limited to tuition revenue associated with each course. The aforementioned masking procedure retains the relations between costs and revenues across course levels, but not necessarily the magnitudes (or even the signs) of the margins. Among other things, the real table shows which courses receive cross subsidies and which contribute to the cross-subsidy pool.

Table 1: Enrollment; Cost, Revenue and Margin, per Student FTE				
College, Department, Course Level	**Student FTE**	**Cost/FTE**	**Revenue/FTE**	**Margin**
Engineering Department A				
Upper Division	208	$17,000	$14,000	($3,000)
Lower Division	464	$12,000	$14,000	$2,000
Humanities, Arts and Social Sciences Department A				
Upper Division	529	$15,000	$12,000	($3,000)
Lower Division	525	$11,000	$12,000	1,000

2. *Number of Lecture Sections, by Class Size Category*. Section counts describe the amount of organized teaching activity engaged in by departments. Counts for discussion sections, labs, and seminars are provided in addition to those for lectures. The ranges for the class size categories vary for the different kinds of classes. For lectures they are small (1-19), medium (20-49), large (50-99), and very large (100+ students).

Table 2: Number of Lecture Sections, by Class Size Category				
College, Department, Course Level	**Small**	**Medium**	**Large**	**Very Large**
Engineering Department A				
Upper Division	3	6	18	9
Lower Division	1	6	13	23
Humanities, Arts and Social Sciences Department A				
Upper Division	4	14	7	23
Lower Division			8	16

3. *Average Enrollment for Lectures, by Class Size Category*. These figures provide a precise measure for average class size within the categories listed above. Large or growing class sizes (or shifts in section count to the larger categories) may indicate that the department is under stress.

Table 3: Average Enrollment for Lectures, by Class Size Category

College, Department, Course Level	Small	Medium	Large	Very Large
Engineering Department A				
Upper Division	1.4	14.3	72.5	336.4
Lower Division	4.4	12.3	97.8	79.9
Humanities, Arts and Social Sciences Department A				
Upper Division	17.0	27.4	46.4	200.7
Lower Division			51.0	321.0

4. *Percentage of Lecture Sections Taught by Non-Regular Faculty, by Class Size Category*. "Non-regular faculty" are defined as all kinds of teachers except "Professor." (The model can support any definition that is desired.) Outliers may suggest situations where the role of regular faculty has been allowed to erode—another indication of departmental stress.

Table 4: Percent of Lecture Sections Taught by Non-Regular Faculty, by Class Size Category

College, Department, Course Level	Small	Medium	Large	Very Large
Engineering Department A				
Upper Division	33.3%	16.7%	5.6%	11.1%
Lower Division	0.0%	83.3%	92.3%	95.7%
Humanities, Arts and Social Sciences Department A				
Upper Division	0.0%	0.0%	0.0%	8.7%
Lower Division	0.0%	0.0%	12.5%	12.5%

5. *Cost Breakdowns for Selected Courses*. This table shows the level of detail at which the tool tracks resource usage and allocates cost. For example, the "Professor" column allocates the total cost associated with the department's professorial teaching activity according to the estimated number of professor hours (contact plus noncontact) attributable to the course. Similar data are available for all courses in the curriculum, and in some cases by section type in specific courses.

Table 5: Cost Breakdowns for Selected Courses

College, Department, Course Level	Teachers of Record				Teaching Assistants	Direct Facilities	Grand Total
	Professor	Lecturer	Tutor	Other			
Engineering Department A							
141: INTERMED DATA STRUCS&ALGRTHM (GRP A – ON CAMPUS – FALL)	$11,800	$0	$200	$200	$1,300	$900	$14,400
141: INTERMED DATA STRUCS&ALGRTHM (GRP A – ON CAMPUS – SPRING)	$5,700	$0	$200	$200	$3,900	$900	$11,000
141: INTERMED DATA STRUCS&ALGRTHM (GRP B – ON CAMPUS – FALL)	$16,000	$0	$100	$100	$1,600	$300	$18,100
Humanities, Arts and Social Sciences Department A							
001: INTRODUCTORY PSYCHOLOGY (GRP A – ON CAMPUS – FALL)	$11,000	$0	$300	$300	$17,900	$3,200	$48,000
001: INTRODUCTORY PSYCHOLOGY (GRP A – ON CAMPUS – SPRING)	$0	$2,700	$300	$300	$22,600	$3,300	$45,200
011: INTRODUCTORY PSYCHOLOGY (GRP A – ON CAMPUS – WINTER)	$18,400	$0	$100	$100	$37,900	$1,100	$68,200

All the cost and margin figures in the tables are "direct" (i.e., not burdened with overhead), which are the data needed for most decision-making at the department and course levels. Burdened figures also are readily available within the model, as are data for costs, revenues, and margins for the university's non-teaching functions.

The familiar aggregate metrics for assessing teaching "productivity" are easily calculated from the data illustrated above. For example, overall average class size for departments can be calculated from Tables 2 and 3, and cost per enrollment or credit hour at the course level from Table 4 (the database includes course enrollments and credit hours). However, it now should be apparent that such figures are too crude to be used for identifying actionable problems and opportunities.

Expected Benefits

We close this essay with a broad description of how we think the enhanced ABC tool can be utilized and what additional development needs to be done in order to facilitate this. The tool is designed to benefit academic as well as financial decision-makers, so the highest-priority immediate task is to intensify our work with deans and chairs to make sure this can happen.

The enhanced ABC tool enables ongoing assessment of the impact of various resource allocation methods and quantifies the level of cross-subsidization throughout an institution.

More Informed Budgeting

The enhanced ABC tool enables ongoing assessment of the impact of various resource allocation methods and quantifies the level of cross-subsidization throughout the institution—thus allowing explicit evaluation of these methods. For any given allocation scheme, prioritizing budget alternatives requires knowledge of costs, revenues, and margins, so the financial results can be balanced against subjective judgments about fulfillment of academic mission [Massy 2016, Ch. 5]. These examples show why academic decision-makers should work together—an objective that the tool can facilitate.

The above applies even at the departmental level, where chairs need to adjust their course rosters and sectioning decisions in response to a combination of budget factors and academic needs. Version 1.0 of the tool can inform decisions about where academic improvement can be accomplished through "growth by substitution" when incremental funding is not available. It provides perspective on the factors—including departmental research—that influence teaching activities and costs.

Improved Planning and Forecasting

The ABC tool enables consideration of planning scenarios based on different strategic choices, and informs student enrollment management and programmatic changes. It can report the costs, revenues, and margins of individual degree programs, which will inform decisions about program re-sizing, differential pricing, and curricular redesign. It will be possible to analyze the costs and financial benefits of developing new degrees—or

eliminating old ones—taking into account the effects on courses in departments outside the major as well as the department's own offerings. The tool can inform analyses of how student dropout affects cost per degree, which is important both internally and for external stakeholders. Some of the above will require additional development along the lines described in Massy [2016, pp. 156-63], but the groundwork has been laid and we don't see any insurmountable difficulties.

The tool also can supply the inputs needed for simulating the effects of forecasted enrollment changes. Doing what-if analysis on the enrollment drivers can inform planners about which courses and departments will be impacted and by how much, and what budget adjustments will be needed to compensate. Some Australian universities employ a "predictive" version of the model for this purpose on a regular basis. Looking further ahead, we foresee how the depth of structure contained in the model can be used to optimize course offerings and the allocation of teaching resources.

Deeper Insights about Course Redesign

The enhanced ABC tool can be used to make improvements to the instructional model even without direct data on learning performance. It can illustrate and validate assumptions about course development/delivery, and it provides actionable data on the costs needed to achieve desired educational outcomes. For example, the activity variables will help department chairs identify "high-stress" and "low-stress" courses, i.e., those where class sizes are above or below limits deemed acceptable for effective learning, and/or where faculty teaching loads are unduly high or adjunct faculty usage has reached dysfunctional proportions. Such courses may be candidates for redesign, or the data may trigger resourcing adjustments. The "stress" idea applies to departments as well as courses. High-stress departments, ones that have a large number of high-stress courses and few low-stress ones, may need to reduce the number of low-enrollment courses in order to reallocate teaching resources. If such reductions would be hurtful academically, the high-stress department will be able to present the Dean or provost with a documented case for more money. (This works in reverse as well: low-stress departments may be candidates for budget reallocation.) For the first time, deans and provosts will have objective evidence about the adequacy of departmental budgets, and be able to work with chairs on making the needed trade-offs between money and mission.

Operational Reform

Finally, university planners will gain perspective on the use of facilities and its effects on teaching costs. The tool can identify the kind of classroom or lab used for each F2F meeting, the cost thereof, and the fraction of seats filled. This opens the way to more efficient scheduling, enables better comparison with online offerings, and helps set priorities for course redesign. Over time, the new perspectives will enable more integration between the university's operating and capital budgets.

University planners will gain perspective on the use of facilities and the effects on teaching costs, enabling more efficient scheduling, better comparison with online offerings, and improved prioritization for course redesign.

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Conclusion

It's still early days for UCR's Version 1.0 enhanced ABC tool, but both the progress to date and the future prospects are exciting. The main tasks on our immediate agenda are to make the model more user-friendly in its reports for financial analysts, build an operational dashboard for departments, and continue to work with the deans and faculty in the five pilot departments on refining the workload profiles and using the results in decision-making. The tight coalition between the provost and CFO that has carried the project to this point will need to continue—and I have no doubt that it will—as it is crucial to the ongoing success of this endeavor.

About the Author

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William Massy, an emeritus professor and former officer of Stanford University, has been active as a teacher/researcher, consultant, and university administrator for more than forty years. After gaining tenure in Stanford's Graduate School of Business, he served the central administration as Vice Provost for Research, Acting Provost, and Vice President for Business and Finance—during which time he developed and pioneered financial planning and management tools that have become standard in the field—and then as Professor of Higher Education working on resource allocation, cost containment, and academic quality assurance and improvement. Massy co-directed the Department of Education's National Center for Postsecondary Improvement from 1996 to 2002, served on Hong Kong's University Grants Committee from 1991 to 2003, and since 2010 has been an Honorary Faculty Fellow at the University of Melbourne (AU). His most recent book is *Reengineering the University: How to Be Mission Centered, Market Smart, and Margin Conscious* (Johns Hopkins University Press, 2016). Massy holds a Ph.D. in economics from the Massachusetts Institute of Technology.

References

Anguiano, Maria (2013), "Cost Structure of Post-Secondary Education: Guide to Making Activity-based Costing Meaningful and Practical." Policy paper from the Bill and Melinda Gates Foundation: Post-secondary Education Success.

Massy, William F. (2016a), Reengineering the University: How to Be Mission Centered, Market Smart, and Margin Conscious. Baltimore: Johns Hopkins University Press.

Massy, William F. (2016b), "Faculty Members Must Play Their Part in Keeping Teaching Costs under Control." *Chronicle of Higher Education* (May 6), pp. A26-A27.

National Research Council. (2012). *Improving Measurement of Productivity in Higher Education. Panel on Measuring Higher Education Productivity: Conceptual Framework and Data Needs.* Teresa A. Sullivan, Christopher Mackie, William F. Massy, and Esha Sinha, Editors. Committee on National Statistics and Board on Testing and Assessment, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Soares, Louis, Patricia Steele, and Lindsay Wayt (2016), "Evolving Higher Education Business Models: Learning with Data to Deliver Results." Washington, DC: American Council on Education Center for Policy Research and Strategy, and the TIAA Institute.

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