

# Editorial: How to Monetize the Value of OR

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In his last months as editor in chief of this journal, the first author was seeking papers for this 40<sup>th</sup> anniversary issue of *Interfaces*. He wanted to generate a final issue with works from folks who were truly in the interface between academia and industry. In the first author's opinion, few currently fit that bill better than the second author.

When approached by the first author about a paper for this issue, the second author happily agreed. We then set upon finding a topic that had not been broached. The first author has been consulting successfully for 20 years or so, but had never landed a project in which the client would agree to a percentage-of-savings fee. He had once come close with a Fortune 100 company. However, the client's boss must have been scared off by the glee in the first author's voice and never approved the deal. The second author has been able to accomplish percentage-of-savings deals, and has created a very successful company based on operations research (OR), while continuing to be a very productive professor. How has he been so successful in navigating the interface? That's what the first author set out to learn and share with the readers of *Interfaces*. The most efficient approach for acquiring this information turned out to be an interview format.

In what follows, the first author (JC) discusses, among other topics, monetizing the value created by OR with the second author (ST) in the hopes that we can all learn from his experiences.

JC: OR methods, when applied appropriately, have created significant monetary and economic value. Most of the time, however, it appears that the OR person who played a role in this value creation does not get a proportional amount in compensation. In your *OR Practice* paper published earlier this year (Tardif et al. 2010), you discuss a project at Deere executed under a gain-sharing agreement. Can you give some details?

ST: I agree with your general observation. The short answer to your question on the Deere project is that it was a 50-50 split based on the value created that can be attributed to this OR effort. In the paper, we show that the value created is clearly incremental over what Deere would have made (or was making from parallel projects, termed as ‘preexisting’ initiatives) had we not done the engagement. Thus, we were paid about \$5 million for this project over a period of 2 ½ years.

As you said, typically, even if an OR project saves \$500 million and wins the Edelman competition (or is a competition finalist), the OR folks on that team most likely make less than \$5 million.

JC: Let’s take a step back. How did you get to this gain-sharing agreement?

ST: This was not our first interaction with Deere. When we were crafting this arrangement during the fall of 2004, we had already done two very successful OR-based projects. One was an Edelman finalist in 2004 (Troyer et al. 2005); as a result of this project, Deere either eliminated or avoided over \$1 billion of inventory. In the second project, we helped Deere save tens of millions of dollars by optimizing its product portfolio (Yunes et al. 2007).

One of the key lessons I learned is that long-term relationships matter. Having a track record of successful outcomes drives future interactions; senior executives want you to be successful. Thus, in the third project, where a key innovation was to tailor the logistics to the two seasons ('peak' and 'off-peak') rather than have it the same for the entire year, the president of Deere's Consumer & Commercial Equipment (C&CE) division sponsored the gain-sharing agreement (with very strong support from the order-fulfillment group) and convinced Deere's CEO to bless it; then, the folks from the CFO's staff made sure that everything was set up correctly.

JC: Can you elaborate more on the structure of the gain-sharing agreement with regard to the benchmark? It seems like getting a meaningful benchmark is key. For example, it seems as if you need to be very mindful of changing market conditions, such as changes in cost of capital, freight rates, and demand.

ST: Yes, we agreed on the benchmark in terms of cost-per-hundred weight (CWT) and total cost (in the two seasons of 2004 ), as well as granular details of lead times, inventory turns, use of different modes of transportation, and such. We knew that we would have to normalize CWT as demand and unit rates changed. For example, if Deere negotiated an improved logistics rate, that amount would be backed out of the calculation of the incremental value of this project. The details on how we dealt with other changing factors are in the paper. The more important lesson here is that this was a collaborative effort to scientifically and logically attribute value created—not an antagonistic system of engagement in which both sides were sparring over what created the value. We had methods of coming to agreeable splits if residual differences remained after data analysis, so that both companies felt that fair decisions were being made, given the

data. We did have one situation in which Deere implemented something in error (or did not implement something as we had agreed); because this reduced the potential value, Deere gave the OR project a positive credit by taking the debit as negative value created by a preexisting initiative. It was quite amazing. For value sharing to work, I believe that great alignment, trust, and mutual respect are critical.

JC: So the previous projects were not gain-sharing arrangements? What was the compensation structure there?

ST: In the first project, Deere purchased enterprise software, consulting, implementation, and many years of ongoing annual support. By its very nature, the total price across many years is in seven figures. It was not a pure gain-sharing arrangement, although it was a very high-profile project with a performance component to it . The second was a fixed-price project; it was not based on time and materials, but was priced appropriately to respect the intellectual property that was developed.

JC: How did you get started at Deere?

ST: Interestingly, I got a call from Deere. A person from the order-fulfillment group had read the *Fortune* article (Seikman 2000) on our work (with Uday Rao and Alan Scheller-Wolf) with Caterpillar. The article was written after the journalist who covers supply chain for *Fortune* saw our *OR Practice* paper (Rao et al. 2000) on this topic, and interviewed a very senior executive at Caterpillar.

JC: What was the compensation structure on that Caterpillar project? How did that project get going?

ST: It was also a fixed-price project. Caterpillar contacted us at Carnegie Mellon (CMU) and asked us to help design a new supply chain that would be responsive yet efficient. Caterpillar had exhausted other possibilities, such as using consulting firms, the company's internal OR group, or Caterpillar Logistics. These executives were looking for some original thinking, and they felt that universities were a good place to find it. The lesson here is that professors should look to do the exciting new projects that consulting firms or internal corporate groups simply cannot do.

We consider our ability to think creatively to be our competitive advantage; it allows us to charge a hefty intellectual premium, and is high-profile to senior executives. These projects allow us to produce high-quality publishable papers (and to create new teaching materials).

JC: So one monetizing mechanism is high-end, fixed-price projects with highly differentiated OR capability and senior-executive visibility. The other is gain-sharing (or value-sharing) projects. Both are consulting-oriented.

Why did you create SmartOps, your enterprise software company?

ST: These mechanisms are not mutually exclusive. You can do value sharing along with enterprise software; we have done such arrangements. My main reason for creating SmartOps was to bring our field's intellectual property in discrete-time, stochastic, multiechelon inventory models into widespread use, and to make global inventory planning a standard practice in the Global 2000 companies—to make it part of their business processes. For that, consulting was not

the appropriate mechanism for delivering the value possible with this type of OR. In fact, neither was desktop software. I decided to build an enterprise solution for the ongoing use of planners, rather than a desktop tool for off-line strategic analysis by (internal corporate or external) consultants; this company is very different from a typical academic-driven company. Therefore, its pricing and “go-to market” strategy are also very different.

JC: Can you elaborate?

ST: Selling a multimillion-dollar engagement at a Global 2000 company requires skill. To do so repeatedly requires a general-purpose solution and a process. For such an engagement to also include enterprise software requires IT support and approval by the company’s capital appropriation committee; I have found this aspect—how to create an efficient machinery to deliver sustainable benefits through OR—to be intellectually interesting in its own right.

The first step is to identify an executive sponsor, typically a senior executive in the line of business (LOB). Helping that executive, who probably has no OR background, appreciate how OR can help him (or her) tackle an important and urgent business matter is crucial. In the case of SmartOps solutions, the business problem is about maintaining or improving service levels, while cutting working-capital investment in an increasingly uncertain and volatile environment. That light bulb has to go on in the executive’s head.

A pilot project—perhaps on a limited sliver of the business—is the next step. During this step, perhaps 6-12 weeks in duration, several things are accomplished; the most important is identifying the sources and locations of value creation at a very granular level (this identification must be achievable with a high degree of certainty). Reducing (and pretty much eliminating) the perceived risk of using OR is critical. Building a very good working relationship with the pilot

team and the future users of the software is equally important. These individuals are the user buyers; they help to create the business case, and they're excited about their future life with OR. This (pilot project) allows the executive to secure the capital and resources, which sometimes requires board approval, to get the project authorized. Interestingly, senior executives (and also middle management) in Global 2000 companies tend to be quite risk averse when it comes to signing up for value delivery, and so will support projects that have a high value component but also a very low risk of failure. We have now done this many times, and are now are signing up at a rate of one to two new customers a month.

The economics of running an enterprise software company is quite simple: the gross margin of software is nearly 99 percent; the company's gross margin is nearly 90 percent because consulting revenues have lower margins. Fortunately, the ratio of consulting revenue to software revenue is 1:2. The other revenue source, annual maintenance, keeps increasing with time as new customers are added; this has good margins as well. We have grown our revenues each year. In the first three years, we made a heavy engineering investment (ahead of revenues); we have been profitable for the last seven years. Thus, in our case, we monetize OR by creating a growing stream of positive cash flow year after year from an enterprise software model. Just to close the loop on the Caterpillar story, Caterpillar licensed our software in 2003; as a result, it reduced inventory in its Building Construction Products Division by over 15 percent and increased its revenues by 2 percent (Keene et al. 2006).

JC: What about examples of the innovative OR work that you mentioned before that fit the high intellectual premium-pricing model?

ST: As a CMU professor, I still do cool projects that are not necessarily in the supply chain space. For example, I worked with Alan Scheller-Wolf and my student, John Turner, to create algorithms for Massive Incorporated (since acquired by Microsoft, perhaps as a competitive response to Google for buying AdSense) for dynamically placing advertisements in multiplayer video games (played over the Internet). Our paper on this is forthcoming in *OR Practice* (Turner et al. forthcoming). This has nothing to do with SmartOps. Within SmartOps, we have a great partnership with our customers, such as Deere, Caterpillar, Kellogg's, and ConAgra Foods, where we do innovative projects; some projects lead to the creation of new enterprise software modules for repeatable sales. One example is the production planning work we did with ConAgra Foods; a paper on this work has been accepted in *OR Practice* (Dawande et al. forthcoming).

JC: Do you still write theoretical papers that are based on your practical experience with customers?

ST: Absolutely! Less than 20 percent of my papers are in *Interfaces* or *OR Practice*; the majority are in the academic mold in journals such as *Operations Research*, *Management Science*, or *Manufacturing and Services Operations Management*. Some of my past and current papers on discrete-time inventory models were motivated by such interactions. For example, working with grocery retailers and their suppliers, such as Heinz, helped us to create a *Management Science* paper on quantity discounts (Altintas et al. 2008) and an *OR Practice* paper (Erhun and Tayur 2003). I would guess that for every one practice paper, three to four theoretical papers are possible. Since 1990 when I graduated from Cornell, I have found this approach of finding innovative projects and then writing a set of papers (one practice, others theoretical) to be



very effective. My first practice paper (Tayur 2000) was published in *Interfaces*; it was based on a coordinated set of operations management (OM) projects—in lean manufacturing, just-in-time (JIT), cyclic scheduling, and kanban systems— at a General Electric plant. This led to two theoretical papers in *Operations Research* (Anupindi and Tayur 1998, Kapuscinski and Tayur 2007) and one in *Management Science* (Keskinocak et al. 2001). Another example from the mid 1990s is the work on scheduling fractional jets for companies such as Netjets and Flight Options (Keskinocak and Tayur 1998).

JC: What is the best way to monetize OR projects? Is there something other than gain sharing?

ST: There is the ultimate capitalistic mechanism: private equity (PE)! In 2001, some of my MBA students created CCG Inc. I am a limited partner and a board member; the business model was to buy out (with leverage using debt) privately held, struggling manufacturing companies, in which the core technologies could be repurposed into new application domains, and professional OM folks plus business development efforts could create significant value. These are then sold to strategic buyers (by running an auction using investment bankers). We have done this full cycle with three companies. The internal rate of return (IRR) of this PE fund is 20.7 percent, well over the cutoff to be in the top quartile (18.4 percent is the IRR for 2001 vintage-year funds). Note that the S&P 500 over this horizon has an IRR of 1.5 percent. One particular company was an amazing experience in which we repurposed a foundry that was making parts for the automotive industry (and struggling because of market share loss to China and that industry's general decline) into making parts for wind energy. Our investment of \$3 million in 2002 returned over \$34 million in 2008. Nearly half of this return can be tied to OM

projects, which improved capacity flexibility, reduced scrap, and institutionalized lean practices, and strong inventory-control techniques.

JC: Any papers on this?

ST: We have teaching materials that I use in my MBA core class, which is very well received. We are planning to write up something that other schools may want to use.

JC: You did not mention consulting firms, such as Accenture or IBM? Do you not see a monetizing mechanism there?

ST: Their model is a high-volume, lower-margin hierarchy pyramid game to drive high utilization of lower-level consultants by higher-level partners. By charging a client \$2,500 per day for a lower-level consultant, but paying the consultant \$1,000 per day, a partner can make \$1,500 per day of gross margin per consultant used. So, if the ratio of consultant to partner is 6:1, the partner can make \$9,000 per day of margin for the partnership if all its consultants are 100 percent utilized. Typically, only a small part of this is OR. Where I think professors have done well is when they have created a low-cost desktop tool (e.g., for network design), and allowed these consulting firms to use it in their own projects. A royalty on a per-use basis creates the cash flow stream to the professor. This monetization of OR has also worked quite well I believe.

JC: What projects are you working on now?

ST: Interestingly, two of the projects I am working on that I really like are both in the nonprofit arena. One includes a clinical study (being conducted by Allegheny General Hospital's

cardiology department) to fully understand the value of genetic information in choosing dosage for the drug, Warfarin. This is in the emerging area of pharmaco-genetics. The key question being asked is whether upfront genetic testing is cost-effective; if so, should insurance (especially Medicare) pay for it? The second project is to understand the supply chain of human trafficking. This is a collaborative project with US Department of Justice and several NGOs that focus on domestic and international trafficking. The focus here is to improve victim identification and increase the prosecution rates of the traffickers. This is a very tough real-world situation, but the work is very rewarding.

## **Conclusion**

The first author looks forward to putting what he learned into practice. We both look forward to reading future *Interfaces* papers on how our readers have profited from this article.

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