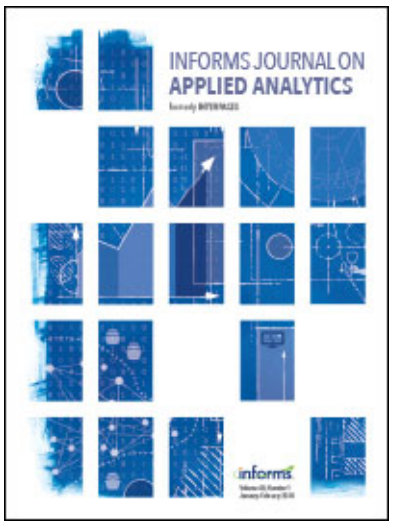

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Integrating Analytics Competencies with Operations and Supply Chain Functional Excellence at the University of South Carolina

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Abstract. The Management Science Department at the Darla Moore School of Business (the University of South Carolina) is the winner of the prestigious 2024 INFORMS UPS Smith Prize. Along with the contemporary offerings in business analytics, our focus on functional excellence in the operations and supply chain domain represents a novel approach to producing analytics-savvy business graduates. In this article, we describe the architecture of the two programs and highlight the academic-industry collaboration innovations that have by their nature and scale led to unprecedented career outcomes for our graduates and benefited our industry partners in multiple ways. We offer details on the design and execution of specific initiatives and hope that more programs will replicate this difficult but effective model to produce graduates with the ability to use analytics as a means for better organizational performance rather than an end unto itself.

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Keywords: Smith Prize • analytics • operations and supply chain • experiential learning • academic-industry collaboration • Lean Six-Sigma

Introduction

With an emphasis on analytics to drive business insights, dedicated academic programs in business analytics (BA; such as Bachelor of Science in Business Administration degrees) are being developed and offered at an increasing rate (Raine 2024). We offer an alternative and compelling vision of preparing future managers who could use data as an enabler to solve actual business problems while still emphasizing functional expertise. At the Management Science Department housed in the Darla Moore School of Business at the University of South Carolina (USC), we have accomplished this goal for future business managers through the implementation of an operations and supply chain (OSC) program along with a symbiotic applied USC-OSC Consulting Center. Our synergistic business analytics concentration and its accompanying Center for Applied Business Analytics (CABA) further strengthen the analytical skills of our students. In this article, we describe these academic offerings and academic-industry innovations that have made our programs uniquely effective by their very nature and scale. We provide details of the architecture, planning, and execution elements of our programs with the hope that more programs will replicate this difficult but effective model to produce graduates with the ability to use analytics as a means for better organizational performance.

School and Department Strengths

The Darla Moore School of Business at USC is an Association to Advance Collegiate Schools of Business-accredited site of academic excellence, with an enrollment of more than 6,000 undergraduate students and 735 graduate students. The school offers a wide range of programs: nine undergraduate majors, eight master's programs, two doctoral programs, the Daniel–Mickel Center for Executive Education, and an annual Economic Outlook Conference that draws widely from the public sector and academia.

No academic program of excellence can be created without competent and passionate faculty. The Management Science Department was started in the 1970s and is currently composed of 33 full-time faculty members (and 5 adjunct faculty members). We have deliberately cultivated a portfolio of expert teachers, researchers, and applied consulting expertise within the department, encompassing the disciplines of operations research (OR), operations and supply chain management, statistics, and business analytics. Our faculty members are reputed scholars in their own fields of research interests, ranking 13th of all North American business schools in a composite score of research productivity in the top three operations management (OM) journals in the 2019–2023 five-year period. Current faculty members have authored more than 400 research

publications in leading scholarly and applied research journals, with an average of 2,350 career citations per research-active faculty member. Several are currently senior editors at leading OM/OR journals, and faculty members have won best research paper awards from the journals *Management Science*, *Manufacturing and Services Operations Management*, *Production and Operations Management*, and *Decision Sciences Journal*. Our faculty are also excellent teachers, winning many university-level, state-level, and international-level teaching awards, but they are also extremely competent practitioners. The OSC faculty members have cumulatively consulted on more than 350 consulting projects through our OSC program.

OSC faculty members have cumulative industry experience of more than 200 years at global organizations and more than 100 years of combined consulting experience. They possess professional qualifications, such as Association for Supply Chain Management (APICS)-Certified in Production and Inventory Management, APICS-Certified in Logistics, Transportation, and Distribution, and American Society for Quality (ASQ)-Six-Sigma Master Black Belt (Schiferl 2018). They scope and lead the execution of value-added projects in OSC for client firms, and they help student teams implement some of the most sophisticated analytic tools. The outstanding abilities of our faculty to use OR tools to solve real-world problems are one of the secrets to our academic programs' success.

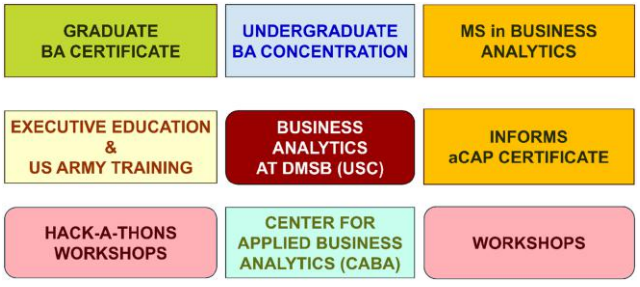
Department Programs and Initiatives

The Management Science Department champions two major programs: (1) a school-wide set of BA offerings and (2) a vibrant OSC undergraduate major and graduate concentration. We first discuss each one separately, and then, we discuss how we combine the two to provide unique student experiences.

Business Analytics Programs and Initiatives

Figure 1 shows the array of BA offerings and initiatives that we have implemented since 2016.

Figure 1. (Color online) USC Business Analytics Offerings and Initiatives



Notes. DMSB, Darla Moore School of Business. aCAP, associate certified analytics professional.

The undergraduate BA concentration was launched in 2016 and currently has an enrollment of 750 students. It uses a matrix approach with a required course (MGSC 394: Data Analytics for Business) and three electives from a set of 10 approved courses across various majors across the school (e.g., ECON 436: Introductory Econometrics, MGSC 390: Business Information Systems, MKTG 447: Pricing Strategy and Analytics, etc.). One feature of our BA curriculum is ensuring every business graduate's proficiency in Microsoft Excel, Microsoft PowerBI, and the open-source statistical analysis language R through their integration into the foundational precursor courses MGSC Computer Information Systems in Business and MGSC 291 (Statistics for Business), which are required of every business major. The graduate BA certificate is pursued by more than 80% of full-time Masters in Business Administration (MBA) students and follows a parallel structure. Additionally, graduate students also get an opportunity to receive a USC BA certificate through their program.

Launched in 2019, the Masters in Business Analytics (MSBA) program is relatively new, and it follows a similar structure of a set of six required courses (MGSC 772: Project Management, MGSC 790: Data Resource Management, MGSC 711: Quantitative Methods, MKTG722: Data Science for Business Decision-Making, MGSC 777: Advanced Quantitative Methods, and a Practicum Project Course or Related Internship) along with four elective courses from a wide range of approved courses across multiple disciplines within the school. Our MSBA program has been selected as one of the pilot programs for the INFORMS Associate Certified Analytics Professional certificate (Olavsrud 2024), where our students are able to secure this valuable external qualification through the MSBA program.

The Practicum Project Course is supported by CABA, which was founded as the academic-industry collaboration initiative. CABA has collaborated with for-profit organizations, such as Blue Cross Blue Shield of South Carolina, and nonprofit organizations, such as the South Carolina Student Loan Corporation and the Final Victory Animal Rescue, for the MSBA hackathons and projects. It manages a dedicated data laboratory and executes cocurricular initiatives of the BA programs, such as hack-a-thons (e.g., Boeing data challenge) and various technical training workshops.

Finally, BA offerings include a very successful executive education initiative (https://www.mooreexeced.com/government-military-solutions/) with four programs: (1) a two-day workshop on artificial intelligence for executives, (2) a one-week Business Analytics Certificate course, (3) a two-week Intermediate Data Analytics Certificate course, and (4) a full four-week Advanced Business Analytics Certificate course. A special accomplishment of the BA executive education relates to our strategic partnership with the U.S. Army. Under this

partnership, we have trained more than 5,000 U.S. soldiers and civilian officers in analytics competencies. The coursework has an applied project requirement, and candidates have executed substantial real-world projects as a part of the program requirements. Some examples of projects under this initiative include the following.

- U.S. Army Pacific: $3 million annual savings through the implementation of a financial modeling of the common operating picture. National Professional Development Institute Award for Cost Saving.
- Combined Security Transition Command—Afghanistan: $22 million cost savings during the first month of the use of an MS Power BI Contract Review Tool.
- Brooke Army Medical Center: $4.5 million cost avoidance using cost analysis.
- Atlantic Resolve: $12 million pay entitlement corrections with a conservative estimate of $70,000 in annual cost avoidance (from automation resolving military pay issues that impact soldier readiness).
- Second Infantry Division Aviation Brigade: $4 million in cost savings from a reduction in erroneous orders after identification of inefficiencies of the ZPARK processes.

These diverse BA educational programs and related initiatives reflect a very strong suite of our business analytics offerings. However, although impressive, our BA offerings alone only make up part of the department's unique value proposition. The marrying of BA competencies into a functional context within our operations and supply chain program is the main differentiator of our department's success.

Operations and Supply Chain Program and Initiatives

The OSC undergraduate and graduate programs are designed to produce students with state-of-the-art knowledge and practical applied experiences in twin competencies of "operations and business process improvement" and "global supply chain design, analysis, and improvement." Currently, the program maintains an enrollment of 800 undergraduate students who have OSC as their primary major and approximately 40 MBA students who are concentrating in OSC (we also have a high-quality PhD program). The OSC major is one of the most popular majors at the business school and has impressive outcomes for graduating students in terms of placement rates, quality of employers, quality of careers/positions, and quality of compensation. Our undergraduate OSC program is one of the largest such programs in North America and is ranked number 3 among the best undergraduate supply chain management programs in North America, and our graduate OSC program is ranked number 5 per the 2024 Gartner Research Rankings (Gartner Research Rankings 2024).

Our programmatic framework recognizes that OSC management spans all processes related to providing the products and services to customers where they want them, when they want them, and at the quality and prices they want them while ensuring long-term profitability and growth of the organization. Thus, the mission of the USC-OSC program is to educate students in business competencies related to the design of high-quality products and services; the design of both internal and interorganizational processes to create and provide these products and services; and the implementation, management, and improvement of these processes.

We prepare our students for specific OSC careers in (1) global manufacturing firms in production, purchasing, quality control, distribution and supply chain management, and internal consulting roles; (2) service firms for general operations management and logistics/supply chain management and internal consulting roles; and (3) consulting firms as business process and operations/supply chain improvement consultants. Even those OSC majors who pursue careers in accounting, finance, international business, marketing, or marketing information systems utilize their OSC knowledge and skills as valuable complementary competencies, and they are consistently sought after for those jobs/careers because of this skill set. In all of these career tracks, students go into functional responsibilities or consulting roles that require them to be competent users of analytics.

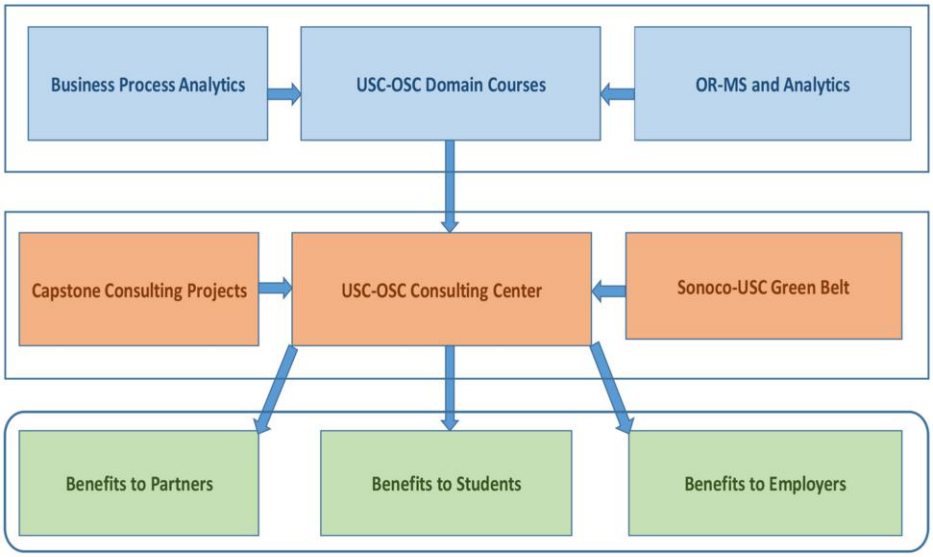
One unique differentiator of our OSC program from many other such programs is that our graduates not only learn the strategies and tactics of world-class operations and supply chain management, they also apply the domain knowledge and analytical skills to substantially improve operations and supply chains in real organizations through live, high-visibility projects *before* they graduate. We strive for our students to be rewarded with industry validation of their demonstrated competencies. We have phrased this goal in our strategic plan as producing graduates who are ready and able to contribute to their employers' top-line and bottom-line performance on day one. A large part of their success comes from honing their critical thinking and analytical skills through real-world industry projects, as described in the next section.

Integration of OR/Management Science and Analytics into the USC-OSC Program

In this section, we highlight the "ideas," "process," and "outcomes" of our USC-OSC program innovations. The overall value proposition of our program is achieved through two major pillars: the *USC-OSC program* and the *USC-OSC Center*. The major components of these two pillars are presented in Figure 2.

We strongly believe that managers and organizations cannot effectively manage and improve their OSC without the ability to view them as business processes and the acumen to systematically improve them using the right balance between simple and sophisticated

Figure 2. (Color online) OSC Program and OSC Center: Pillars of Innovation



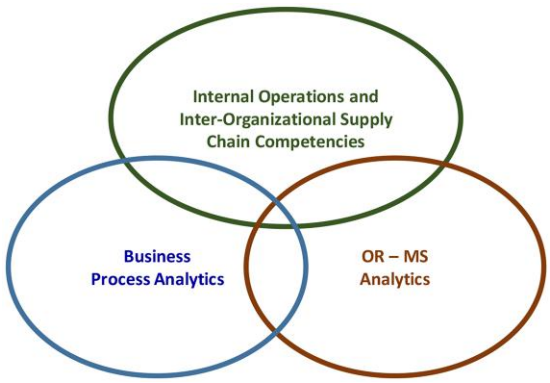
analytics. Paraphrasing the late Mr. Smith—after whom the UPS Best Management Science Program award is named—"as organizations grow and become global, OSC problems increase geometrically. Without the ability to research and improve OSC processes using just the right analytic tools, we risk analyzing these challenges only intuitively, potentially foregoing substantial opportunities to accrue maximum efficiency and effectiveness out of our operations." We have embraced this holistic view of the critical enabling role of business process analytics and the suite of valuable analytic tools from operations research and management science (MS) to maximize the OSC capabilities in our USC-OSC program (see Figure 3).

Our program prepares students with analytical competencies in the OSC functional domain using OR/MS and process analytics. On the OR/MS front, students learn systematic OR/MS techniques, such as time series forecasting models; linear, integer, and nonlinear programming; multiple-criteria decision making; network flow models; transportation algorithms; decision trees; and program evaluation and review technique/critical path methods. On the process analytics front, they learn classic qualitative Lean Six-Sigma tools (e.g., value stream mapping, sort, set in order, shine, standardize and sustain, process maps, measurement systems analysis, fishbone diagrams, affinity diagrams, failure mode effects analysis, and fault tree analysis) as well as sophisticated quantitative statistical analysis using regression, analysis of variance (ANOVA), multivariate analysis of variance (MANOVA), design of experiments, and advanced process modeling using queuing and simulation.

The key to understanding and mastering the "tools" and "techniques" of both types (OR/MS and process analytics) is that they should be integrated within a specific body of knowledge context. We have deliberately and successfully integrated OR/MS techniques into OSC domain coverage (e.g., yield management, total supply chain cost modeling, transportation optimization, inventory optimization, network optimization, demand management and forecasting, and multiple criteria decision making). In addition, several data analytics techniques are taught (and subsequently used) in our courses and projects, such as linear and nonlinear regression, data visualization (using Excel, Tableau, and PowerBI software), database reporting using Structured Query Language, data-mining techniques, and geographic information systems. Students learn a wide variety of OSC analytics software, including Excel Solver, Minitab, POM for Windows, SAP, ProcessModel and SimQuick Simulation Software, SAP, R, and Python.

The USC-OSC undergraduate program includes the following MGSC courses: (1) MGSC 290: Computer Information Systems in Business; (2) MGSC 291: Statistics for Business and Economics; (3) MGSC 393: Innovation and Design; (4) MGSC 485: Business Process Improvement; (5) MGSC 486: Service Operations

Figure 3. (Color online) USC-OSC Program—Role of Analytics



Management; (6) MGSC 487: Global Sourcing Strategies and Application; (7) MGSC 489: Sustainability in Operations and Supply Chains; (8) MGSC 491: Supply Chain Management and Modeling; (9) MGSC 492: Logistics, Transportation and Distribution; (10) MGSC 495: Supply Chain Planning and Control; (11) MGSC 497: Capstone OSC Consulting Project; and (12) MGSC 498: Project Management. A similar structure has been established for the MBA-OSC concentration (courses with numbers higher than 700).

Table 1 presents the matrix of OR/MS and analytics coverage in our MGSC courses at the undergraduate and MBA levels. We believe that this matrix approach reinforces the applied nature of OR/MS and analytics competencies by contextualizing the application of these techniques, and hence, when students and managers face actual problems, they can correlate them with the needed tools/competencies. Functional managers understand the utility of these analytical techniques better when they associate a tool/application with an actual problem that they want to solve. OR/MS and data analytics taught within the domain context of OSC management and within the comprehensive Lean and Six-Sigma operations/process improvement framework allowed us to offer a very practical, competent set of graduates who are able to apply the tools effectively to improve organizational performance even before the start of their professional career. This is borne out by the unprecedented speed with which (and the extent to which) our graduates have contributed to their organizations both before and after graduation. Even more importantly, the capability to ask the right questions, collect/seek the right data, and choose the right analytics tools to provide cost-effective solutions has enabled our graduates to thrive in a wide variety of functional and analytics careers.

Operations and Supply Chain Center

To achieve our goal of graduating students who can hit the ground running on day 1 of their careers and to ensure their long-term competence, we convened the companion USC-OSC Center in 2005. Over the last 19 years, we have engaged in long-term strategic partnerships with more than 45 leading organizations. Examples of these partner firms are shown in Table 2. A core value proposition for these strategic partners is our OSC Capstone Consulting Projects Model. Our partners have benefited significantly from these projects in terms of both strategic and tactical improvements of their operations and supply chains as well as the world-class talent graduating from the program.

The OSC Center was historically composed exclusively of large for-profit organizations that paid an annual membership fee. In 2019, after many substantial experiential learning projects were executed pro bono through the OSC program's feeder courses (not MGSC 497) with various nonprofit organizations, we formally launched the "USC-OSC Humanitarian Operations and Supply Chain Initiative" with a focus on integrating social mission nonprofits, such as food banks, homeless shelters, and other social service organizations, into our Operations and Supply Chain Center. Our efforts on this front have already led to valuable projects in organizations such as The United Way Association of South Carolina, Harvest Hope Food Bank, and South Carolina Clinical and Translational Research (affiliated with the Medical University of South Carolina).

OSC Capstone Consulting Project Model

The Capstone Consulting Project experience (MGSC 497 and MGSC 897) is a formally structured 4.0 credit-hour experience with the center team consisting of a faculty consultant and four to six students as well as a client team consisting of the project sponsor/process owner and process participants. These projects are undertaken on a semester timetable and require multiple site visits (as necessary), primary and secondary data collection, regular teleconferencing, piloting and implementation of recommendations during the project and follow-up after the projects, and formal client presentations using the design, measure, analyze, improve, and control (DMAIC) framework. Note, however, that these projects utilize whatever (tools) are most appropriate to solve the problems at hand, not boxing ourselves into camps, such as Lean, Six-Sigma, OR/MS, etc. Most projects blend multiple techniques from different technical domains. Finally, these are not class projects. They are mentored by faculty consultants who have a balanced approach to their teaching and scholarship, and they are quite practical (e.g., accompanied by multiple publications in *INFORMS Journal on Applied Analytics* (*IJAA*), formerly *Interfaces*). Client executives who have "real" vested interest in significant improvement of their business unit or corporate-level performance sponsor the projects, and then, they implement the recommendations. The typical timeline for our projects is shown in Figure 4.

Three Legs of the Stool Driving OSC Center Success

Students are the first leg of the triad. The primary goal of the Capstone projects is to prepare students for the successful application of their domain knowledge and analytical skills. Thus, students are provided with resources that they can tap into. But they are expected to take the lead on the Capstone projects from week 1 to week 14 of the semester. Because of the stringent timeline of one semester, faculty mentors identify the project topic just before the semester in collaboration with the client sponsor. However, once the team is assembled, students take ownership of the project launch to the final deliverables. They manage the schedule and client

Table 1. Matrix Approach to OR/MS and Analytics Coverage

Undergraduate/MBA course	MGSC 291/792	MGSC 395/791	MGSC 485/789	MGSC 486/873	MGSC 489	MGSC 487/771	MGSC 491/776	MGSC 495/875	MGSC 497/897	MGSC 394/777	MGSC 779
ANOVA/MANOVA	X		X						X		
Data visualization	X	X	X	X					X	X	
Descriptive statistics	X	X	X	X			X		X	X	
Design of experiments			X						X		X
Linear programming (MIP, NLP, goal programming)			X				X		X		
Forecasting and demand management		X					X	X	X		
Game theory							X				X
Hypothesis testing	X		X	X					X		
Inventory models		X				X	X	X	X		
Lean and Six-Sigma		X	X		X			X	X		
Line balancing		X	X						X		
Linear programming		X	X	X			X		X	X	
Linear regression	X		X	X			X		X		
Location models (including GIS)		X	X	X			X			X	
Logistic regression			X	X					X	X	
Multiple-criteria decision making		X				X	X		X		X
Network optimization		X		X			X		X	X	
Pricing analytics				X		X	X				
Probability distributions	X	X	X	X			X		X		
Process layout analytics		X		X					X		
Process simulation modeling			X						X		
Production planning, materials resource planning		X						X	X		
Project management		X	X						X		X
Queueing models		X	X	X							
Revenue management				X			X				
S&OP, master production scheduling		X	X					X	X		
Scheduling models		X	X					X	X		
Statistical process control and quality control		X	X	X				X	X		
Supply chain modeling		X			X	X	X		X		
Theory of constraints and capacity planning		X	X	X				X	X		
Total cost of ownership modeling					X	X					
Value stream calculations		X	X						X		

Note. MIP, mixed integer program; NLP, nonlinear program; GIS, geographic information system; S&OP, sales and operations planning.

Table 2. Sample of USC-OSC Center Strategic Collaborations

Strategic collaborations	Additional strategic collaborations
Adidas	McLeod Health
Alpek Polyester	Medical University of South Carolina
Avaya Telecom	Michelin
Atrium Health	Nephron Pharmaceuticals
BMW	Palmetto Health
Boeing	Pfizer
Coca-Cola Bottling	Price Waterhouse Coopers (PwC)
Colonial Life	Schaeffler
Continental Tire	Schneider Electric
Daimler	Siemens
Delta Airlines	Smith and Nephew
Cummins Engines	Snider Tire
Cummins Turbo Technologies	Sonoco Products Company
Eaton Electrical	South Carolina Department of Education
Electrolux	Trane-Ingersoll Rand
EZGO-Textron	United Technologies Aerospace Systems
Flextronics	UPS
Harvest Hope Food Bank	Walmart
Johnson & Johnson (J&J)	Westinghouse Electric

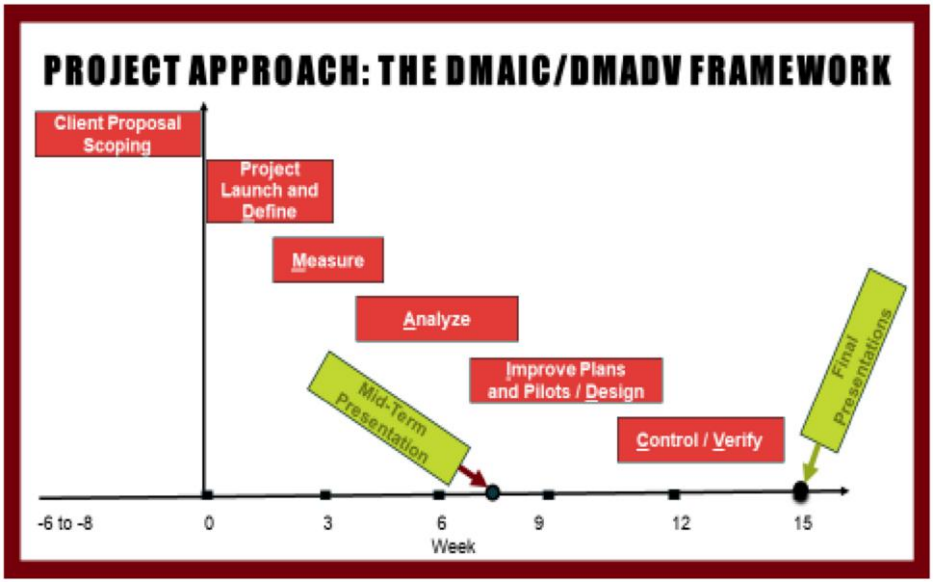
interactions, visits, and meetings. Students work with faculty mentors in internal team meetings to refine the project definition and scope, map the project process, and identify data needs. In consultation with the faculty mentor, they develop a detailed client interactions and data collection plan.

Students work diligently and professionally to ask the right questions, collect the right data, and apply the appropriate analytics to propose a range of improvements (not just one) along with operational and business justifications. On many of the projects, students plan and implement pilots and report improvements. Finally, a detailed "control" plan is developed and delivered. It is not uncommon for teams to invest more than 1,200 person-hours on the projects (although at four credits and with five-person teams, it should amount to approximately 1,000 person-hours). They exhibit a great sense of professionalism and responsibility.

Faculty mentors, the second leg of the stool, view this initiative as their calling. They serve as the sounding board for the student teams. Mentors are involved in students' communications with clients and monitor the actual work as a broad guardrail. Students are expected to ask questions and brainstorm the use of various analytic tools as well as set milestones for the project. Faculty mentors assess and provide guidance using Socratic questioning if some specifics are substantially misaligned with project goals. It helps to have faculty with proven expertise in field applications of the sponsoring firm's industry. The core center faculty members collectively represent professional work experience in OSC improvement exceeding 100 years; one Six-Sigma Master Black Belt; two Six-Sigma Black Belts; Lean Consultants; winners of school, university, and professional (Production and Operations Management Society and INFORMS) teaching awards; and—most of all—mentors who are equally competent in using process analytics (Lean Six-Sigma), OR/MS, and analytics.

Client sponsors are the third stakeholder. Client sponsors are expected to propose front-burner and complex projects (often projects that are beyond the client's current capacity and/or capability). They are required to assemble a client project support team consisting of a project coach, a team interactions' coordinator, and a data

Figure 4. (Color online) USC-OSC Capstone Project Framework



person in addition to actual client managers/process owners. The client team is expected to be responsive to the project's needs (data, assessment of ideas etc.), with the expectation to implement the recommendations from the projects (not shelve the project reports).

Because the project teams have a track record of delivering high-value solutions, client managers trust the quality and hence, challenge our students with useful and substantive projects. During the projects, they become ambassadors of the team within their organizations, and they help to keep the project moving through the coordination of data and resources from their end on the project.

Project Preparation and Resources for Students

We expect competency and consistent hard work on projects from students, but we also facilitate it through multiple efforts before and during the Capstone experience. The feeder courses and especially the business process management course (MGSC 485) have integrated field projects into their course requirements. MGSC 485 has provided students the preparatory experience in applying the systematic DMAIC/Define, Measure, Analyze, Design, and Verify (DMADV) approach to nonprofit organizations, such as SC HIV AIDS Council, Harvest Hope Food Banks, SC Thrive, The Free Medical Clinic, Sisters of Charity of South Carolina, The Midlands Family Promise and The Transitions (homeless shelters), and Ronald McDonald House of Charities. Some of these projects turn out to be as comprehensive as Capstone Consulting Projects as illustrated by two of the MGSC 485 projects executed at Harvest Hope Food Banks, which are ultimately being published in *IJAA* (Ahire and Pekgün 2018, McKie and Ahire 2024). These projects in the nonprofit sector enhance students' confidence and competence in applying OR/MS and analytics tools and develop a broader social conscience in our students about the power of these tools to tackle broader societal challenges.

During the Capstone course, we provide a step-by-step 78-page "How-to Manual" for executing projects. This manual includes tips on how to structure work in every major phase of the project, but it also includes time management tools, professional communication and client coordination tips, dress codes and calls/meetings prep standard work, note-taking guidelines, and standard PowerPoint presentation design templates. Students also attend focused workshops on data analytics, project management, teamwork and conflict resolution, and any specialized software/tools needed for their projects.

Consistent feedback over the last 11 years from client managers, employers, and alumni validates the value of the Capstone project model—including our attention to detail in developing students' analytical/technical and organizational savvy. The vision and efforts invested in this model have met and often exceeded expectations of industry managers at some of the largest leading organizations, with favorable assessment of the significance and quality of our teams' work vis-à-vis their internal teams as well as their engagements with professional consultants.

How Do OSC Projects Ensure the Meaningful Use of Analytics?

There are many programs that incorporate some level of Capstone project experience for our undergraduate (and graduate) students. So, what makes USC-OSC Center projects unique and innovative? The answer lies in our deliberate, detailed, and professional approach to the design and execution of these projects. The scale, scope, target audience, and rigor of these projects, along with an emphasis on end-to-end planning, execution, and sustenance of improvements, are what create a unique value proposition.

Projects Scope Range

We have designed the project experience to be a focused consulting engagement for a front-burner challenge in our strategic partner organizations. The project scope goes far beyond what a typical classroom project would entail. The center projects span from improving patient cycle times in the emergency department at Atrium Health to redesigning the entire global supply chain network for Cummins to optimizing internal logistics for break-pack items for health and beauty departments for 1,000 Walmart stores to redesigning the warehousing and transportation networks for Continental Tire, Siemens, and Sonoco to developing optimal statewide retail donations pickup logistics for Harvest Hope Food Bank.

From a geographical footprint perspective, projects have covered single-department, single-facility, and site-based projects, such as patient-room and clean supply room inventory projects for Atrium Health and shop-floor improvements for Cummins Turbo, Continental Tire, Trane, and Nephron Pharmaceuticals. They also cover projects at the firm level, such as improving global internal logistics (e.g., Continental Tire, Siemens, Sonoco, and Walmart) and global external logistics (e.g., Avaya, Cummins, Coca-Cola Bottling, Continental Tire, Pfizer, and Siemens).

Projects Visibility and Sponsorship

The student projects are typically linked to the performance incentives and metrics for the sponsoring division/sponsoring managers. Thus, they have the highest level of visibility. The projects and their deliverables reach the highest level of client organizations. For example, final presentations are often attended by 15–40 of the top managers of the client organization (almost

always at the level of vice president (VP) and senior VP and often including even executive VP, chief administrative officer, managing director, chief executive officer (CEO), and president). Often, project work sessions and final presentations are attended by managers from multiple countries. In many instances, projects serve as benchmarks of best practices that managers from other parts of the sponsoring organization utilize to transfer recommendations and insights to their areas of responsibility.

Proving Value—the Final Frontier. It is worth highlighting that we have strategically partnered with Price Waterhouse Coopers (PwC) as a client—a global leader in consulting. Students have engaged in 12 high-profile projects at five different lines of service at PwC: the Tax Consulting Division, the Global Procurement Division, the Global Information Reporting Division, the New Business Ventures Division, and the Anti-Money Laundering Division. They have ranged from global staffing optimization, developing new business ventures resource planning tools, and developing supplier selection tools to improving the effectiveness of antimony-laundering practices. These projects have helped PwC in rethinking their internal processes and have served as catalysts for improvements in their consulting practices delivery.

Cultivating Critical Thinking at the Project Definition Stage

The *first principle of project execution* that we hone is "understand the problem and goals first. Don't let 'data' be your starting point." Each project starts with a careful definition of the project, including process scope, key performance indicators, and goals of process improvement. We ask clients not to talk about data or perceived solutions. The worst thing that a project team could do is to solve the wrong problem simply dictated by available data or based on a suboptimal/wrong solution in mind.

We have consistently followed this principle through formal project charters and through our systematic application of the Lean Six-Sigma DMAIC approach. As one example, McLeod Health wanted the Capstone team to help the schedulers of the cleaning staff for patient rooms. The objective was to improve their (schedulers') workstations and reduce their nonvalue-add times, allowing them to focus on quickly adapting room assignments to available staff and overriding room monitoring and assignment software. Using the DMAIC approach, however, allowed the team to identify that the real root-cause problem was the suboptimal schedule that was developed by the software, which assigned staff to rooms inefficiently, resulting in the need for constant reassignment of the rooms. After brainstorming internally, the student team helped the client revise the project goal to "improving the quality of rooms assignment logic to improve room cleaning request response time" (thus, also improving staff satisfaction and the overall quality of the room cleaning process). With this updated goal, the team then used data on 72,000 room drops and their response and total turnaround times to develop customized shift optimization models for different days of the week for different seasons. Thus, instead of helping the scheduling function reduce marginal nonvalue-add times, our team worked on the goal of developing optimal schedules, thus substantially reducing their rework while achieving the true goal of cleaning the rooms quicker and better and improving cleaning staff's satisfaction (McKie and Ahire 2024).

Scoping the Project Right

The *second principle of project execution* that we engrain in our students is "set the guardrails right." Often, projects can fail because of too narrow or too broad a scope. Through experience, we have learned to scope a project that can be accomplished within three months with a team of five analysts (students) and one faculty expert. In fact, a lot can be accomplished if the scope is focused on the most important problems. We invest a lot of time in coaching teams (and client managers) in setting up the guardrails. The focus is on completing a substantive project that has specific recommendations and possibilities for real improvement rather than just analyzing a huge problem and running out of time to deliver improvements.

For example, working with Snider Tire (Ahire and Jensen 2017), our team started with the goal of improving the production-transportation network costs for the entire United States but quickly scoped the project to cover the Southeast region, which had a major portion of the total transportation costs; however, the smaller scope was more manageable to generate recommendations that could be piloted in the Southeast and later translated to the Western and Northeast regions. Another project team narrowed down the scope of optimizing Walmart's internal logistics using two important dimensions of scope: restrict the scope to the Southeast region with one Central Distribution Center—seven Regional Distribution Centers—each serving about 100–150 stores (thus resulting in footprint of about 1,000 stores). Within this geographical footprint, the team selected the two most proliferated departments for inventory placement—health and beauty (covering more than 30,000 stock-keeping units (SKUs)).

We have used the scoping methodology often to split a larger project into two self-sufficient and complementary projects across two semesters. For example, we conducted the larger project on global staffing optimization for PwC's Anti-Money Laundering Practice client engagements into a two-semester sequence of projects.

The first project team completely mapped out the process with estimates of lead times, resources, quality factors, and variations in productivity based on resource maturity, resource location, and other attributes. The team then developed a comprehensive Excel-based planning tool for estimating and quoting project duration and optimal staffing combination (maturity and location mix). This would serve as a *quote enabler*. In the second semester, another project team developed a client engagement monitoring and adaptive planning tool that allows managers to develop adaptive resource plans that optimize staffing based on project updates, allowing the user to analyze project progress and staff productivity using a Microsoft PowerBI dashboard.

Avoiding Data Dredging

Our *third principle of project execution* practiced on each project is "relevant, valid, and adequate data open doors to success." (The converse is that irrelevant, invalid, inadequate, or too much data lead to data dredging but no useful outcomes.) The first two principles allow our teams to map out a relevant project. This correct project with the right scope then leads to asking the right questions about data. Which data are relevant to solving the problem? Where do we find the data? How do we collect the data? How much of the data is enough? We give several examples of how we have helped both our student teams and client teams to think about data as an enabler and not as an end unto itself.

Which Data to Use. This question is asked after the student team maps out the process at the heart of the project. For example, data questions about emergency department patient flow projects are not asked until the patient flow process is mapped, key performance customer indicators—quantitative (cycle time and readmit) and qualitative (patient satisfaction)—are identified, and at least some understanding of key inputs is established (process network, resources, customer demand pattern, and customer attributes of importance). A good understanding of the process leads to better data needs identification for a distribution center, manufacturing shop floor, logistics network improvement, or any other functional processes.

Although our partners sometimes make data available at the start of the semester, we encourage students to first focus on project definition, scoping, and mapping of the current process for the first two weeks and then define the data needs precisely. This helps prevent unfocused efforts to get or review data that might not be relevant while missing out on data that would be more critical to project success. This principle has helped many of our client teams improve their perspective on improvement projects and the role of data in these projects. For example, on a project with Siemens for designing new customer-facing fulfillment metrics, the student team identified data needs at a more specific level that was necessary to compare the efficacy of existing methods to measure performance vis-à-vis our recommended approach. For a project with the Palmetto Health radiology department on the inventory integration for two hospital facilities, the team had to collect historical usage rates for more than 2,000 SKUs at both locations for multiple years in order to make consolidation recommendations. All of these data needs were precisely identified and communicated with the corporate partners, which were then productive and prompt in extracting the data from their information systems.

Data—How and How Much. One key success factor for our projects has been a holistic approach to developing an understanding of the problem or current state of the process and drivers for improvement. This involves collecting the right data, which are valid and from reliable sourcing. Any typical Capstone project entails data collection using a wide range of sources and methods grouped into primary data, secondary data, and subject-matter experts. These are illustrated in Table 3 (primary data), Table 4 (subject-matter experts), and Table 5 (secondary data). Some projects use all three methods of data collection. For example, healthcare patient treatment improvement projects have utilized secondary data on tens of thousands of patient visits (in one case, 140,000 visits) to understand patient arrival patterns and their diagnosis-related group code distribution; primary data through multiple on-site visits at emergency departments, urgent cares, or physician practice for collecting data on process flow and steps' times and resource assignment logic; and working with subject-matter experts (doctors and nurses) on developing administrative and clinical improvements.

Note that depending upon the nature of the project, the student teams spend several hundreds of person-hours collecting primary data on site through numerous visits at different times of the day (and night) based on project needs. Especially for facility-based projects, we stress the importance of "process immersion" to understand the determinants of process performance. The salient features of primary data collection are presented in Table 3.

As for data from subject-matter experts, teams have interacted with everyone from janitors to truck and forklift drivers to plant managers to directors to VPs to even presidents and CEOs to gather insights that cannot otherwise be collected through primary or secondary data methods (see Table 4). As an example of this emphasis on collecting direct feedback from key client participants, for the UTAS project to help design digital dashboards for global commodity managers and supplier performance managers, the team conducted more than 75 formal structured interviews (each lasting

Table 3. Primary Data Collection

Primary data collection approaches	Examples
Longer travel (multiple-day) visits	Johnson & Johnson (NJ, TN), Delta Airlines (GA, MN), Hilex Poly (PA), Sonoco (IL, IN, OH, TN), Siemens (GA, MS), Walmart (AK)
Day drives	Avaya, Atrium Health, Coca-Cola Bottling, Cummins, Daimler, Sonoco, BMW, Daimler, McLeod Health, Eaton, Textron
Data collection during 1st shift, 2nd shift, 3rd shift	BMW, Atrium Health, Coca-Cola Bottling, Cummins, Daimler, McLeod Health, Palmetto Health, Textron, Trane
Data collection using data collection forms and stopwatches	BMW, Atrium Health, Coca-Cola Bottling, Cummins, Daimler, McLeod Health, Palmetto Health, Textron, Trane
Videos of shop floor (sometimes durations of multiple shifts)	Coca-Cola Bottling, Trane
Data collection at various facilities	Manufacturing shop floors, distribution centers, rides on routes, hospital ED, acute care departments, blood laboratories, stores, yards

Note. AK, Alaska; ED, emergency department; GA, Georgia; IL, Illinois; IN, Indiana; MN, Minnesota; MS, Mississippi; NJ, New Jersey; OH, Ohio; PA, Pennsylvania; TN, Tennessee.

30–60 minutes) with managers from all major continents.

Many projects, especially those focusing on logistics, distribution, and supply chain design improvements, have used large amounts of data provided to the teams by client firms from their data warehouses. Several examples are given in Table 5. The scale and diligence of collecting the right type and amount of data from the right sources are the important differentiators between our Capstone projects and other class projects or some external consulting projects.

Targeted, Goal-Driven Analytics

Determining how to use the right tools to solve the right problems is a good demonstration of converting knowledge into practice. We stress this *fourth principle of project execution* throughout our coursework but especially during Capstone projects. Our student teams have successfully utilized a blend of simple process analysis tools from the Lean and Six-Sigma domains (flow time and throughput calculations); qualitative conceptualization tools, such as affinity diagrams and fish-bone diagrams; semiquantitative tools, such as process failure mode and effects analysis; statistical tools from simple descriptive statistics to linear, nonlinear, and logistic regression; and ANOVA/MANOVA and design of experiments to sophisticated OR/MS tools, such as optimization and simulation. Over the years, our student teams have shifted from using visualization techniques from Excel and Minitab to more advanced data visualization tools, such as Tableau and PowerBI. Numerous projects have utilized ProcessModel simulations to mimic transactional processes for modeling and assessing important improvements so as to gain the client team's confidence in the team's recommendations before implementations. Teams routinely develop Excel-based models for OSC projects using advanced Excel features (including Macros and VisualBasic), OpenSolver optimization software, ProcessModel simulation software, Minitab, and R for more advanced

Table 4. Data from Subject-Matter Experts

Subject-matter experts	Examples
Physicians, nurses, staff	Atrium Health, McLeod Health, Palmetto Health
Managers from North America and other continents	Continental Tire, Cummins, Johnson & Johnson, Siemens, UTAS
President, CEO, Managing Director, Executive SVP, Chief Administrative Officer	Coca-Cola Bottling, Atrium Health, Colonial Life, Harvest Hope Food Banks, Palmetto Health, PwC, Walmart
VP, directors	Continental Tire, Cummins, Daimler, Textron, PwC, Westinghouse
Plant managers, production managers, supervisors, supply chain managers, commodity managers, DC managers, quality managers	Adidas, BMW, Cummins, Daimler, Siemens, Sonoco, Textron, Trane, UPS
Operators, dispatchers, call center operators, salespersons, laboratory technicians, truck drivers, mechanics, pickers, packers, shippers, janitors and cleaning staff	Atrium Health, Coca-Cola Bottling, Colonial Life, Delta Airlines, Eaton, Johnson & Johnson, McLeod Health, Schneider Electric, Lexington Medical Center, Palmetto Health
Customers, suppliers	Atrium Health, Cummins, Continental Tire, Johnson & Johnson, Harvest Hope Food Banks, Siemens, Textron
Service providers, 3PLs	Coca-Cola Bottling, Continental Tire, Delta Airlines

Notes. 3PL, third-party logistics company. SVP, senior vice president, DC; distribution center.

Table 5. Secondary Data Examples

Project example	Secondary data
Atrium Health	Consumption by day for 600 SKUs for 2 years
Continental Tire	Inventory position for 420 SKUs by day for 18 months
Colonial Life	7 million records on prospective new subscribers
McLeod Health	141,000 patient visits for coding improvement project
McLeod Health	72,000 patient discharge room drops
Siemens	1.2 million shipments into global distribution center
UPS	14 million shipments for global freight forwarding
Walmart	Shipments from 7 RDCs into 1,000 stores for 30,000 SKUs

Note. RDC, regional distribution center.

statistical analysis. Table 6 highlights examples of how we have mentored our students to use targeted analytics using the right techniques to reach valuable insights and improvement strategies.

Closing the Loop—Ensuring Success

The final and *fifth principle of project execution* that we espouse is that of closure. Great analytics without actual implemented solutions is only a job half done, and this mistakes analytics as the final objective and not a means to an end. Our projects invariably identify multiple alternative strategies to improve upon the status quo and present a relative prioritization of alternative options using detailed cost-benefit-risk analysis. Many recommendations challenge the client managers' prior perceptions about potential solutions, exposing them to new ways of thinking and of what is possible.

Pilot Implementation. Almost all projects involve piloting at least some of the recommended improvements. For example, using detailed simulations, project teams presented a combination of recommendations for both Atrium Health Emergency Department patient flow improvements and McLeod's largest primary care practice. For the Atrium Health project, the team evaluated the impact of triage before it was built. For the McLeod project, the team worked with seven physicians jointly to develop standing clinical orders for authorizing nurse practitioners to conduct patient pretests for strep, flu, electrocardiogram, and urinalysis tests. Initially, the healthcare providers were apprehensive about our foray into these clinical domains, but they quickly realized the benefits of cutting down the average patient waiting times by more than 20 minutes. For the project on Walmart.com's distribution centers, the new algorithm for carton mix was piloted and later adopted across their entire e-commerce logistic network.

Final Presentation. Each project concludes with a detailed final presentation that archives the work details, logic, and cost-benefits of the team's recommendations. Final presentations typically range anywhere from 75 to 150 slides, and presentations are made in the presence of client teams and senior management (some have been attended by up to 40 managers). It is common to have senior leadership of the business unit or client firm attend these projects. We have had presentations attended by many managers in person plus others from across the United States and from other international locations. As students present and answer all questions for two to three hours, they have received compliments from leaders of client firms regarding the accuracy, rigor, and practicality of the projects and the professionalism of the students.

Full Implementation. Overall, many of the recommendations on the projects are piloted before the end of the project, whereas others occur within three to six months of the project. Deliverables include any models developed, training manuals, and actual end-user training in using the analytical models and solutions. Implementations have included changing layouts, changing production/scheduling/staffing policies, changes to the supply chain network (relocating or building new warehouses or Distribution Centers (DCs)), evaluating new suppliers, and changing production/service processes. Even major decisions about modifying supply chain configurations and revising metrics of assessment have been made in response to our projects. For example, Coca-Cola Bottling redesigned its warehouse layout and pick-pack procedures based on the recommendations of one of our student teams. Continental revised its warehouse centralization strategy. McLeod Health implemented suggested improvements across its physician services network. Trane designed a new assembly line and process for the flow of raw materials at one of their copper coil plants. Michelin now uses our forecasting models for predicting new tire sales in developing production and inventory plans, and also, Michelin implemented our recommendation to open a new distribution center in Florida. Palmetto Health integrated its inventory systems for intervention radiology directly based on our student team's recommendations. UPS implemented the recommendations from our student teams' sophisticated big-data analytics projects into

Table 6. Examples of OR/MS and Analytics Used in Projects

No.	Project (*Interfaces*/*IJAA* publication)	Approach and tools
1	Colonial Life—modeling predictors of never-effects (balks) in insurance policy sales (Fall 2007)	Logistics regression (more than 75 variables)
2	Production scheduling for J&J—OCD blood products plant (Fall 2010)	Optimization of annual production plan
3	Call center customer service improvement at Colonial Life (Fall 2010) and Delta Airlines (Fall 2016)	Simulation analysis to improve process improvement and throughput
4	Copper demand forecasting for Eaton Electrical	Attribute-based forecasting; ARIMA for estimating demand of copper for procurement and production decisions
5	Sonoco—improving paper rolls transportation network from paper mills to conversion plants (Fall 2011)	Network optimization (warehouse location and transportation) for 6 paper mills and 35 conversion plants across the United States
6	Trane coil manufacturing cell improvement (Fall 2009): Jensen et al. (2013)	Simulation, ANOVA for improving cell throughput
7	Walmart global logistics inventory—transportation optimization for health and beauty department SKUs for the Southeast network of 1,000 stores (Spring 2009)	Optimization of inventory positioning for 30,000 SKUs through the network and at stores
8	Warehouse pick floor optimization for Coca-Cola Bottling and Atrium Health	Excel-based dynamic distance minimization; simulation to improve velocity
9	Carton-mix optimization for Walmart.com DCs (Spring 2011): Ahire et al. (2015)	Advanced analytics to reduce total material, handling, and transportation cost
10	Michelin-Snider—plant-stores-customers network flow optimization (Spring 2012): Ahire and Jensen (2017)	Linear programming; GIS-based transportation optimization
11	Carolinas Healthcare System and McLeod Health patient throughput improvement projects (4 projects; Spring 2013 to Fall 2017)	Theory of constraints; simulation to improve patient cycle times cost effectively
12	Harvest Hope Food Banks—outreach efforts optimization to increase meals yield (Fall 2015): Ahire and Pekgün (2018)	Linear integer programming to allocate operating budget, trucks, forklifts, and staff and management time across 34 promotion initiatives, yielding 1.72 million additional meals per year
13	Harvest Hope Food Banks—kids cafe hot kitchens and supply transportation optimization (Fall 2015)	Simulation; network optimization to supply hot food to more than 1,600 kids (extendable to 70,000 kids)
14	Medium voltage systems business unit supply chain improvement and shipment packaging improvement (Spring 2016)	Simulation; MANOVA to reduce lead times and product damage across international supply chain
15	Improving customer service through JIT shipments to correct DCs from central DC for Continental Tire (Fall 2015 and Spring 2016)	Multiechelon inventory optimization with transshipment to reduce inventory while maintaining customer service levels
16	SC HIV AIDS Council—outreach efforts optimization to reach maximum at-risk clients (Fall 2016)	Linear integer programming to allocate operating budget and volunteers' and medical professionals' times across 19 outreach initiatives to double the outreach span to the population at risk
17	McLeod Health—patient room cleaning staffing optimization (Spring 2018)	Cyclic scheduling using linear integer programming to enable 30% more room cleans with current staff level
18	PwC—antimoney-laundering project engagements quoting and operational execution decision support tools (Fall 2017 and Spring 2018)	Global staffing MIP optimization and PowerBI Analytics to provide a competitive advantage for client engagement planning and execution
19	Siemens—redesign of transportation network for U.S. suppliers into Mexico (Spring 2018)	Total transportation optimization and PowerBI analytics resulting in the redesign of the network with substantial cost reduction
20	UPS sales force coverage modeling (Fall 2018)	PowerBI and Tableau analytics; optimization of territories to improve sales with the current workforce

Notes. ARIMA, autoregressive integrated moving average. JIT, just in time; GIS, geographic information system; MIP, mixed integer program.

revising and refining their national sales strategy for their freight-forwarding business.

Postproject Sustain Road Map. Every project is required to complete postproject sustenance documentation, including control plans, process audits and responsibilities, training manuals, and user training for new processes, and it must include any models/tools developed as part of the final deliverables. The goal of the regimented "sustain plan" is to archive the project methods of data collection and analysis and the tools usage to a level that ensures that the project analysis is replicable and that the new process is usable without any need to contact any of our team members.

USC-OSC Semiannual Industry Summit. At the end of every semester, we hold a showcase Semiannual Industry Summit to celebrate the work accomplished by all project teams. The summit often features a two-hour Voice of Clients session where the client sponsor presents the highlights of the project and commitments made to implementing the recommendations. This is followed by a professional conference-style Projects Poster Board session, where students defend their work to more than 200 attendees (including other teams; industry partner sponsor teams; select employers; potential partner firms; and university leadership, including the school's Dean, Provost, and President). Often, company managers take the poster boards as benchmark templates for internal use.

Sonoco-USC Lean Six-Sigma Green Belt Initiative

The Sonoco Products Company and the OSC program have teamed up to offer the Lean Six-Sigma Green Belt Certification opportunity to our OSC students through a two-phase process.

- Phase 1. Green Belt training and readiness examination.

We have blended Sonoco's internal Green Belt curriculum (mirroring the ASQ Six-Sigma Green Belt body of knowledge) with broader and more sophisticated process analytics from OR/MS and analytics disciplines into training through our MGSC 485 (Business Process Management) course. The Final Green Belt Examination covers all topics and consists of 100 questions in a closed-book format. The passing threshold is 80 of 100. OSC students get only one opportunity to take and pass the examination.

- Phase 2. Green Belt-certified project.

The OSC Capstone Consulting Project constitutes the "project" requirement of this initiative. The project is evaluated for Green Belt certification jointly by an ASQ-certified Six-Sigma Master Black Belt-certified faculty member from the Management Science Department and a corporate Lean Six-Sigma Champion from Sonoco Products Company. If a project is deemed Green Belt worthy, a detailed assessment of each individual team member's contributions to the project is conducted through peer evaluation, a faculty mentor's assessment, and Sonoco's interview of the team members. Only when a student meets all of the criteria of phases 1 and 2 are they are awarded the "Sonoco-USC Lean Six-Sigma Green Belt Certificate."

The deliberate integration of domain competencies and analytics skills has enabled the USC-OSC program to offer a one-of-a-kind experiential learning and career development opportunity to our undergraduate and MBA students. To our knowledge, there is no other business or engineering program that (1) has integrated the domain expertise in OSC management with process competencies as well as OR/MS and analytics using the Lean Six-Sigma framework; (2) has integrated a systematic consulting experience of an "industrial-scale" project through the program; and (3) has enabled students to graduate with a comprehensive "industry-validated Lean Six-Sigma Green Belt Certificate" on such a large scale (more than 1,300 undergraduates and more than 300 MBA students have been certified to date).

Although there are many other programs that offer Lean Six-Sigma Green Belt certifications, our certification and associated prerequisites on the body of knowledge and experience requirements make it a transformative qualification. Our graduates are analytics savvy while also able to maximize the utility of those analytical skills by asking the right questions and using the right tools and techniques to solve real business problems—not just becoming tools experts in analytics. This competency has enabled them to thrive in a wide range of careers, including but not limited to those in operations and supply chain.

Testimonials from numerous graduates of the program over the years from leading employers, such as BMW, Deloitte, Ernst & Young, GE, Google, IBM, Intel, Johnson & Johnson, Nordstrom, PwC, Tesla, The Gap, and Wells Fargo Bank, highlight the value of our approach. We believe that the Sonoco-USC Lean Six-Sigma Green Belt initiative within our program has bridged the discipline of the Lean Six-Sigma DMAIC/DMADV framework and tools with advanced OR/MS and analytics to yield a powerful set of critical thinking and analytical competencies.

We are bound by nondisclosure agreements on our projects from mentioning specific results, but in the aggregate, the value of our projects and recommendations easily exceeds $330 million in recurring cost savings over a 10-year horizon. Moreover, our center partners have increasingly engaged our teams to not only complement their process improvement capacity but also, specifically add new capabilities.

OSC Capstone Projects' Outcomes for Students

Our graduates have competed successfully with other top-ranked programs in business school operations and supply chain management programs and in industrial engineering programs to obtain top-tier functional and consulting positions. Table 7 shows a sample of the major employers of our programs. A great majority of our students secure their first full-time jobs at least one semester ahead of their graduation. Many graduates have joined operations, manufacturing, and supply chain leadership tracks at the companies that they join. Our program has consistently placed our students at a more than 90% placement rate, and it now ranks as one

Table 7. Sample of USC-OSC Employers

Top consulting employers	Top manufacturing employers
Accenture, Bain, Boston Consulting Group, Deloitte, Ernst & Young, Goldman Sachs, Manhattan Associates, McKinsey & Company, Price Waterhouse Coopers	3M, Audi, BMW, Boeing, Bosch, Caterpillar, Coca Cola, Collins Aerospace, Continental Tire, Cummins, Eastman Chemical, Eaton, Electrolux, GE, Lockheed Martin, Honeywell, Johnson & Johnson, Mars, Mercedes-Benz, Michelin, Nephron Pharmaceuticals, Nestle, Newell-Rubbermaid, Northrop Grumman, PepsiCo, Pfizer, Rolls Royce, Schneider Electric, Siemens, Sonoco, Raytheon, SpaceX, Tesla, UTC, Volkswagen
Top hi-tech employers	**Top retail and service employers**
Amazon, Apple, Dell, Meta, Google, IBM, Intel, LinkedIn, Microsoft, SAP	Atrium Health, American Airlines, Bank of America, BCBS, Delta Airlines, Home Depot, L'Oreal, Lowes, Nordstrom, Southwest Airlines, The Gap, Target, Wells Fargo National Bank

of the largest supply chain programs in North America, with concurrent impressive placement and salary outcomes (Gartner Research Rankings 2024).

Many of our graduates who go into process improvement consulting careers acquire the Black Belt certification at these firms soon after joining. Graduates joining top consulting firms often end up performing at the top level of their cohorts within these companies. Graduates also advance quite rapidly in their careers; many succeed in truncating their leadership rotations, securing multiple promotions within a short period of time, and rising into the middle and upper management levels within the first three to five years. A 2019 survey of our OSC graduates revealed that graduates increased their compensation by an average of 40% within three years of graduation—an indication of the market value of their competencies from the OSC program (very few of our undergraduate OSC students feel the need to pursue an MBA or Masters of Science degree within three years of their graduation).

Concluding Remarks

In this paper, we have presented the highlights of the academic programs and companion initiatives in the business analytics and operations and supply chain programs at the University of South Carolina. To our knowledge, this is the first instance of an academic department winning the coveted INFORMS UPS Smith Prize for successes in integrating OR/MS and analytics into a functional program beyond the classic dedicated business analytics offerings. Although our BA offerings are impressive, numerous excellent programs around the world possess similar attributes. What distinguishes our department is how we have seamlessly integrated OS/MS and analytics into our carefully designed and implemented OSC program. In the contemporary practitioner and academic world, there is a worthwhile focus on enhancing an organization's analytics competencies. However, to reap true benefits of these competencies to help organizations perform better, we need to evolve the focus from creating "tools experts" to producing "expert users of tools." This is precisely what the OSC program at USC has distinguished itself with.

We have described the architecture, logic, planning, and execution of our operations and supply chain initiatives that have produced unprecedented outcomes for students and partner organizations and that have catapulted our programs into top five rankings among the best supply chain programs in North America. With all of its interconnected moving parts (program, center, Capstone projects, and the Green Belt initiative), our model is difficult to replicate. But, with devoted and competent scholarly yet practice-focused faculty, committed and open-minded industry partners, and competent and career-focused students, such innovations are possible. We hope that more programs across the world will subscribe to this perspective of what it means to excel at analytics.

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