MEASI
Institute of Management

SUPPLY CHAIN ANALYTICS CASE STUDY

Case Study 1: Reducing Customer Service Call Wait Times at Tele Connect

TeleConnect, a regional telecommunications provider serving over 500,000 customers, was facing a critical customer retention problem. Their average call wait time had ballooned to 8.5 minutes, resulting in a concerning 15% call abandonment rate and customer satisfaction scores hovering at just 6.5 out of 10. The company was hemorrhaging approximately 200 customers monthly, directly attributable to poor customer service experiences. The executive team green-lighted a Six Sigma project to address this crisis before market share eroded further.

The project team began the Define phase by establishing clear objectives: reduce average wait time to under 3 minutes and lower call abandonment to below 5%. They identified the Critical to Quality characteristic as the time elapsed from when a customer enters the queue until they connect with a live agent. During the Measure phase, the team collected three weeks of call center data encompassing over 15,000 calls. Their analysis revealed that the baseline average wait time was 8.5 minutes with a standard deviation of 3.2 minutes. They discovered pronounced peaks during 9-11 AM and 2-4 PM, when wait times averaged 12 minutes. The process capability index was a dismal 0.45, indicating the process was incapable of meeting customer expectations.

The Analyze phase uncovered several critical root causes through statistical analysis and Pareto charting. Inadequate staffing during peak hours accounted for 45% of the variance in wait times. The team discovered that average handling time per call was 12 minutes, significantly higher than the industry standard of 6-8 minutes. Furthermore, their analysis revealed that approximately 30% of incoming calls could theoretically be resolved through an improved Interactive Voice Response system, and there was a 20% efficiency gap between the best and worst performing agents. These findings pointed to both capacity and capability issues.

In the Improve phase, the team implemented a comprehensive solution package. They redesigned shift schedules to add six agents during identified peak periods and developed an enhanced IVR menu system capable of handling the 15 most common customer inquiries. A two-week intensive training program was rolled out to all agents to standardize best practices and improve efficiency. The team also created a real-time

dashboard that allowed supervisors to redistribute calls dynamically based on queue depth and established a callback option for customers facing wait times exceeding five minutes. Finally, in the Control phase, they implemented X-bar and R control charts to monitor daily average wait times and established monthly performance reviews with team leaders to ensure sustained improvement.

The results exceeded expectations. Average wait time plummeted to 2.8 minutes, representing a 67% improvement over baseline. Call abandonment rates dropped to just 3%, and customer satisfaction scores jumped to 8.2 out of 10. The financial impact was substantial: the company realized annual savings of $450,000 from reduced customer churn alone, delivering a first-year ROI of 340%. The new process capability index of 1.33 indicated the process was now capable of consistently meeting customer expectations. Perhaps most importantly, the improvements were sustained over time through the robust control mechanisms put in place.

Discussion Questions:

1. The case study mentions that 30% of calls could potentially be resolved through an improved IVR system. What are the potential risks and drawbacks of routing more customers to automated systems rather than live agents? How would you balance efficiency gains with customer experience, particularly for customers who prefer human interaction or have complex issues that don't fit the IVR menu options?
2. The team identified a 20% efficiency gap between the best and worst performing agents. What additional data would you want to collect to understand the root causes of this variation? Propose a systematic approach to capture and transfer knowledge from high-performing agents to the entire team while considering factors such as experience level, call types handled, and individual working styles.
3. The solution involved adding six agents during peak hours. As a Six Sigma practitioner, how would you use queuing theory and capacity planning models to determine the optimal number of agents needed? What trade-offs would you consider between service level, cost, and agent utilization rates when making this staffing decision?

Case Study 2: Decreasing Manufacturing Defect Rate at Precision Automotive Components

Precision Automotive Components manufactured critical safety parts for major automobile manufacturers, with brake pads being one of their highest-volume product lines. Production Line 3, which ran three shifts and produced 2.4 million brake pads annually, was experiencing a defect rate of 12,000 DPMO, corresponding to a sigma level of just 3.8. This translated to roughly 28,800 defective brake pads per year reaching customers, resulting in costly warranty claims, customer complaints, and a damaged reputation. The annual cost of poor quality had reached $2.1 million, including scrap, rework, warranty processing, and the intangible cost of customer dissatisfaction. Senior management mandated a Six Sigma project to address this quality crisis.

The project team conducted a thorough Define phase, establishing the project scope around brake pad manufacturing on Line 3 and identifying three primary CTQ characteristics: surface finish quality, dimensional tolerances within specification limits, and material composition consistency. During the Measure phase, the team performed a comprehensive current state mapping exercise, identifying eight distinct process steps with 15 CTQ characteristics to monitor. They conducted a Measurement System Analysis using Gage R&R studies, which confirmed their measurement system was acceptable at 18% (below the 30% threshold). The team then categorized defects and found that surface irregularities accounted for 45% of all defects, dimensional variations for 30%, material inconsistencies for 15%, and other causes for 10%. The baseline process capability index was Cpk = 0.89, confirming the process was not capable of meeting specifications.

The Analyze phase employed multiple statistical tools to identify root causes. Using 5 Whys analysis and Ishikawa fishbone diagrams, the team traced surface irregularities back to inconsistent mixing processes due to manual timing controls. They discovered that press temperature varied by ±15°C when specifications called for ±5°C, and incoming raw material quality was not being verified consistently. Additionally, tool wear was not being monitored systematically, leading to progressive degradation in part quality. Hypothesis testing through ANOVA confirmed that temperature variation was significantly correlated with defects ($p < 0.01$). The team then conducted a Design

of Experiments using a 2^3 factorial design to optimize the three most critical parameters: temperature, pressure, and cycle time. The DOE revealed optimal settings that minimized defect occurrence.

The Improve phase focused on implementing permanent solutions to address root causes. The company invested in an automated mixing system with programmable timers to eliminate human variation. They upgraded press temperature controllers to achieve ±2°C accuracy, well within specification. A new incoming material inspection process was established using XRF spectrometry to verify material composition before use. A predictive maintenance schedule for tooling was implemented based on production counts and wear patterns. Most importantly, they optimized process parameters based on the DOE findings: temperature set to 185°C, pressure to 2,400 PSI, and cycle time to 42 seconds. The Control phase established Statistical Process Control charts for all CTQ characteristics with automated alerts for out-of-specification conditions. Standard Operating Procedures were updated and prominently displayed, and an operator certification program was created to ensure consistent application of the improved process.

The transformation was dramatic. The defect rate dropped to 1,200 DPMO, a 90% reduction, pushing the sigma level from 3.8 to 4.6. The process capability index improved to Cpk = 1.45, indicating a capable and robust process. Warranty claims decreased by 78%, significantly improving customer relationships and company reputation. The financial impact was substantial: $1.85 million in annual savings with a payback period of just four months. Beyond the quantifiable benefits, the project created a culture of continuous improvement on the production floor, with operators now actively engaged in identifying and resolving quality issues before they impact customers.

Discussion Questions:

1. The team used a 2^3 factorial Design of Experiments to optimize temperature, pressure, and cycle time. Explain why DOE is superior to the traditional "one-factor-at-a-time" approach for process optimization. What insights can factorial designs provide that sequential testing cannot? If you had to add a fourth factor to investigate, what would you choose and why?
2. The case mentions implementing predictive maintenance based on production counts and wear patterns. How would you develop a predictive model for tool
3.

   replacement? What data would you need to collect, and what statistical methods would you use to determine optimal replacement intervals that balance quality risk against maintenance costs?
4. The Gage R&R study showed 18% measurement system variation. While this is acceptable (below 30%), it still contributes to overall process variation. What strategies could you employ to further improve measurement system capability? Discuss the business case for investing in better measurement equipment versus accepting the current measurement variation.

Case Study 3: Improving Hospital Emergency Department Throughput at Metropolitan Medical Center

Metropolitan Medical Center, a 300-bed hospital serving a diverse urban population, was struggling with Emergency Department overcrowding and extended patient wait times. The average length of stay in the ED had reached 6.2 hours, well above the national benchmark of 4 hours for non-admitted patients. Patient satisfaction scores languished at 62%, and the hospital was experiencing frequent ambulance diversions, during which emergency medical services had to bypass the facility and transport patients to other hospitals. This not only impacted patient care and community service but also resulted in lost revenue and damaged the hospital's reputation. The Chief Medical Officer initiated a Six Sigma project to address these critical operational and quality issues.

The Define phase brought together a multidisciplinary team including ED physicians, nurses, laboratory staff, radiology technicians, and admissions personnel. The project charter clearly stated the goal: reduce ED length of stay to 4 hours for non-admitted patients while maintaining or improving quality of care. The team established that the project scope would focus on the complete door-to-discharge process for non-critical patients. During the Measure phase, comprehensive value stream mapping identified 23 distinct process steps in the patient journey. The team conducted detailed time studies on 200 patients over two weeks, breaking down each segment: triage to room assignment averaged 45 minutes (target: 15 minutes), room assignment to physician evaluation took 38 minutes (target: 20 minutes), physician evaluation to lab results required 85 minutes (target: 45 minutes), decision-making to discharge preparation took 22 minutes (target: 15 minutes), and discharge completion to actual patient

departure consumed 35 minutes (target: 10 minutes). Waste analysis revealed a staggering 3.8 hours of non-value-added time per patient visit.

The Analyze phase employed Lean tools alongside Six Sigma methodology to identify root causes. The team discovered there was no fast-track system to separate low-acuity patients, who comprised 35% of total ED volume, from those requiring more intensive evaluation. Laboratory specimens were being transported in batches every 90 minutes rather than immediately, creating unnecessary delays. Radiology scheduling was performed manually, resulting in an average 45-minute delay even when equipment was available. Discharge instructions were being prepared sequentially after physician orders rather than in parallel during the visit. Room turnover and cleaning between patients averaged 28 minutes due to inadequate staffing. A spaghetti diagram exercise revealed excessive movement patterns, with nurses walking an average of 4.2 miles per 12-hour shift due to poor layout and supply organization. These findings pointed to fundamental process design flaws rather than individual performance issues.

The Improve phase implemented a comprehensive set of Lean solutions. A dedicated fast-track area was created with a nurse practitioner assigned specifically to handle ESI Level 4 and 5 patients (low acuity). A pneumatic tube system was installed to transport lab specimens immediately upon collection, eliminating batch processing delays. Electronic radiology scheduling was implemented with real-time capacity visibility, allowing immediate booking when equipment became available. The discharge process was redesigned so nurses could prepare instructions during the visit rather than waiting for final physician orders. A new ED technician role was created dedicated to rapid room turnover, with a target of 15 minutes. Supply rooms were reorganized using 5S methodology based on frequency of use and workflow patterns. The team piloted these changes for four weeks, making adjustments based on staff feedback before full implementation. The Control phase established a real-time dashboard displaying current ED metrics visible to all staff, instituted daily huddles to review previous 24-hour performance, created monthly control charts for length of stay by ESI level, implemented quarterly patient satisfaction surveys, and documented standard work for each role.

The results transformed the Emergency Department. Average length of stay dropped to 3.8 hours, a 39% improvement that exceeded the original goal. Fast-track patients were being discharged in an average of just 2.1 hours. Patient satisfaction scores jumped to 84%, and ambulance diversions decreased from 15 per month to only 2 per month.

Staff satisfaction also improved as overtime hours decreased due to better workflow. The financial impact was substantial: increased capacity allowed the hospital to serve more patients, generating an estimated $2.3 million in additional annual revenue. Perhaps most importantly, the improvements enhanced the hospital's ability to fulfill its mission of providing timely, high-quality emergency care to the community.

Discussion Questions:

1. The team identified that 35% of ED patients were low-acuity cases suitable for fast-track treatment. Critics might argue that creating a fast-track system allocates resources away from critically ill patients. How would you defend the fast-track approach from both a quality-of-care and operational efficiency perspective? What metrics would you monitor to ensure high-acuity patients are not negatively impacted?

2. Value stream mapping revealed 3.8 hours of non-value-added time per patient. However, not all "waiting time" is pure waste in healthcare. Patients may need time for medications to take effect, symptoms to evolve, or test results to return. How would you distinguish between necessary process time and true waste in a healthcare setting? What framework would you use to determine which delays are acceptable versus which should be eliminated?

3. The spaghetti diagram showed nurses walking 4.2 miles per shift due to poor layout and supply organization. While 5S methodology improved supply organization, fundamental layout constraints in existing buildings often cannot be changed without major construction. What creative solutions would you propose to reduce travel distance within existing physical constraints? How would you prioritize layout improvements versus other interventions when resources are limited?

Case Study 4: Reducing Accounts Payable Processing Time at RetailCorp International

RetailCorp International, a Fortune 500 retail corporation with over 2,000 stores and annual revenues exceeding $15 billion, was experiencing significant problems in their Accounts

Payable department. The average time to process an invoice from receipt to payment had ballooned to 45 days, far exceeding the industry benchmark of 15 days.

This extended processing time had serious consequences: the company was incurring approximately $960,000 annually in late payment penalties, missing opportunities to capture early payment discounts that could save millions, and damaging relationships with key vendors who threatened to impose stricter payment terms. The CFO commissioned a Six Sigma project to overhaul the AP process and bring it in line with industry best practices.

The Define phase established a clear problem statement: AP processing time exceeded industry benchmarks by 250%, causing financial losses and vendor relationship problems. The goal was to reduce processing time to 15 days while maintaining proper financial controls. The project scope encompassed the entire process from invoice receipt through payment completion. Initial analysis indicated that the annual cost of delays totaled $1.2 million, combining late fees and lost early payment discounts. During the Measure phase, the team mapped the complete process and identified 12 handoffs between departments and 8 approval levels that invoices had to navigate. Analyzing 1,200 invoices revealed a mean processing time of 45 days with a standard deviation of 18 days, and shockingly, 22% of all invoices required rework due to errors or missing information. When the team separated actual "touch time" (time someone was actively working on the invoice) from wait time, they discovered that only 3 hours was actual work, while 44.5 days consisted of waiting in queues, sitting in inbox folders, or awaiting approvals. This meant 89% of the cycle time was non-value-added waiting.

The Analyze phase employed multiple tools to understand root causes. A SIPOC diagram revealed a fundamental disconnect between the Purchasing, Receiving, and Accounts Payable departments, with no standardized communication protocol. Root cause analysis using the 5 Whys and fishbone diagrams uncovered several critical issues: three-way matching (purchase order, receiving document, and invoice) was performed manually and consumed 65% of total processing time. Approval hierarchies required sequential sign-offs regardless of invoice amount, meaning a $100 office supply invoice went through the same approval chain as a $100,000 capital equipment invoice. Forty percent of invoices arrived without purchase order numbers, causing them to be routed to the wrong department initially, where they sat until someone redirected them. The entire system was paper-based, requiring physical routing of documents through multiple offices and floors. Additionally, there was no visibility into invoice status, causing vendors to call repeatedly with inquiries, which further distracted AP staff. Regression analysis confirmed that invoice amount and purchase

order presence were significant predictors of cycle time, validating the team's hypotheses.

The Improve phase involved substantial process redesign and technology implementation. The company deployed an e-invoicing system with automated three-way matching capability, eliminating the manual comparison process. They established tiered approval thresholds based on risk: invoices under $5,000 with successful three-way matching were auto-approved, invoices between $5,000 and $50,000 required single approval, and only invoices exceeding $50,000 required dual approval, with approvals now happening in parallel rather than sequentially. A vendor portal was created that allowed vendors to look up their purchase orders and submit invoices directly into the system. Automated exception routing with business rules was implemented to handle non-conforming invoices efficiently. For the remaining paper invoices, OCR technology was deployed to convert them to electronic format. The team trained vendors on the new system and achieved 95% adoption within eight weeks. The Control phase established a daily exception report highlighting any invoice aging beyond 10 days, created a weekly KPI dashboard tracking average processing time and exception rates, implemented monthly vendor scorecards shared with procurement, scheduled quarterly process audits to ensure compliance, and documented standard work with screen shots for all roles.

The transformation exceeded expectations. Average processing time dropped to 12 days, a 73% reduction that beat the original 15-day target. Invoices requiring rework fell from 22% to just 4%. Late payment penalties were completely eliminated, saving the projected $960,000 annually. The company began capturing early payment discounts aggressively, realizing $285,000 in additional annual savings. Processing cost per invoice decreased from $12.50 to $3.80 due to automation and reduced touches. Total annual savings reached $1.8 million. The sigma level improved dramatically from 2.1 to 4.2, indicating a much more capable and predictable process. Vendor relationships improved significantly, with several key suppliers offering preferential terms due to RetailCorp's reliable payment performance. The AP team, initially resistant to change, became advocates for the new system as their workload became more manageable and focused on true exception handling rather than routine processing.

Discussion Questions:

1. The solution involved implementing tiered approval thresholds with auto-approval for low-value invoices with successful three-way matching. What risks does this introduce regarding fraud, errors, or control weaknesses? Design a control framework that maintains efficiency while ensuring adequate segregation of duties and fraud prevention. What compensating controls would you recommend, and how would you monitor their effectiveness?

2. The case mentions achieving 95% vendor adoption of the e-invoicing portal within eight weeks, but 5% of vendors still submit paper invoices. What strategies would you employ to achieve higher adoption rates? For vendors who absolutely cannot or will not use electronic invoicing (perhaps small suppliers or individual contractors), what process would you design to handle these exceptions efficiently without creating a parallel system that adds complexity?

3. Regression analysis identified invoice amount and PO presence as significant predictors of cycle time. This insight could be used to develop a predictive model for invoice aging. How would you build such a model, and how could it be used proactively to prevent delays before they occur? What other variables might you investigate as potential predictors, and how would you validate the model's accuracy over time?

Case Study 5: Optimizing Hotel Check-in Process at Horizon Business Hotels

Horizon Business Hotels, a chain of 15 mid-scale business hotels located in major metropolitan areas, was receiving increasingly negative feedback about their check-in process. The average check-in time had crept up to 8.5 minutes per guest, and during peak periods between 4-7 PM on weekdays, queues often extended to 12 or more waiting guests. Online reviews on TripAdvisor and Google consistently cited long check-in waits as a primary complaint, contributing to an overall rating of just 3.8 out of 5 stars. In the competitive hospitality market, where guests have numerous options and reviews significantly influence booking decisions, this was causing lost business and threatening the brand's reputation. The Vice President of Operations launched a Six Sigma initiative to standardize and optimize the check-in process across all properties.

The Define phase established clear objectives: reduce average check-in time to 3 minutes while maintaining the personal service experience that business travelers valued. The Critical to Quality characteristic was defined as the elapsed time from when a guest arrives at the front desk to when they receive their room key and directions. The project scope encompassed all 15 hotel locations, focusing on the standard check-in process for guests with reservations. The business impact was significant: low review scores were affecting booking rates, particularly from online travel agencies where reviews were prominently displayed. During the Measure phase, the team conducted time-motion studies observing 500 check-ins across five representative properties. Current average check-in time was confirmed at 8.5 minutes with a standard deviation of 2.8 minutes. Breaking down the process into discrete steps revealed: ID verification took 45 seconds, system lookup and reservation retrieval took 90 seconds, payment processing consumed 120 seconds, room assignment required 60 seconds, key card creation took 45 seconds, explanation of hotel amenities and services took 120 seconds, and providing directions to the room required another 90 seconds. Peak times were definitively identified as 4-7 PM on weekdays, when 68% of daily check-ins occurred, and front desk agents were busy 85% of the time during these peak periods.

The Analyze phase dissected where value was truly being created versus where time was being wasted. Value stream analysis revealed that only 3 minutes of the 8.5-minute process actually created value from the guest's perspective, meaning 5.5 minutes were various forms of waste. Root cause analysis using the 5 Whys and process mapping identified multiple problems. The property management system required 12 screen clicks to complete a standard check-in, with each screen loading slowly. Credit card authorizations failed approximately 15% of the time due to connectivity issues or card problems, requiring retries that added significant time. Guest questions about amenities and hotel services, while important for customer service, extended the interaction considerably. Room assignments were being made at the moment of check-in rather than being pre-assigned, creating unnecessary decision time. Manual key card encoding took 45 seconds per card due to older equipment. There was no self-service option available for tech-savvy guests who preferred speed over personal interaction. Interestingly, correlation analysis revealed that guests enrolled in the loyalty program who had pre-registered checked in 45% faster on average, suggesting that front-loading information gathering could significantly reduce desk time.

The Improve phase implemented a multi-faceted solution set that balanced technology with maintained personal touch. The IT team worked with the property management system vendor to streamline the check-in workflow to just 4 clicks, consolidating multiple screens. For loyalty program members, credit cards on file were pre-authorized at 2 PM on the day of arrival, eliminating payment processing time and retry failures at check-in. The operations team implemented a policy of pre-assigning rooms at 2 PM on arrival day based on guest preferences in their loyalty profile and current inventory. A mobile check-in app was developed that allowed guests to check in digitally and receive a mobile room key on their smartphone, bypassing the front desk entirely. Welcome folders containing detailed amenity information, dining options, and area attractions were placed in guest rooms, eliminating the need to explain these at the desk. For mobile check-in users who needed receipts or had questions, self-service kiosks were installed in the lobby. During peak periods, bell staff were cross-trained to assist with simple check-ins for guests without special requests. The Control phase implemented automated daily reports showing average check-in time by property, established a mystery shopper program with quarterly visits to each location to ensure standards were maintained, tracked mobile app usage and guest satisfaction weekly, updated Standard Operating Procedures in the chain's training portal, and instituted monthly best-practice sharing calls between properties to spread innovations.

The results transformed the guest arrival experience. Average check-in time dropped to 2.8 minutes, representing a 67% improvement and exceeding the original 3-minute goal. Peak-time queue length fell to an average of just 3.2 guests. Mobile check-in adoption reached 42% among eligible guests within six months, with higher rates among frequent travelers. Online review scores improved to 4.6 out of 5 stars, with check-in delays rarely mentioned in reviews. Guest satisfaction surveys specifically addressing the check-in process showed 91% satisfaction. The operational improvements generated $180,000 in annual labor savings across the chain by reducing the time front desk agents spent on routine check-ins. An unexpected benefit emerged: with faster check-ins, agents had more time for meaningful guest interactions, and they began proactively offering upgrades and promoting hotel amenities, generating an additional $125,000 in annual revenue. The sigma level improved from 3.5 to 4.8, indicating a highly capable and consistent process across all properties.

Discussion Questions:

1. The solution included implementing a mobile check-in app with digital room keys, which 42% of eligible guests adopted. This means 58% of guests still preferred traditional check-in at the front desk. What factors might influence this adoption rate, and how would you segment guests to understand who adopts mobile check-in versus who doesn't? Design a change management strategy to increase adoption to 60-70% while respecting guest preferences for personal interaction.

2. The case mentions that bell staff were cross-trained to assist with simple check-ins during peak periods. What are the potential risks and quality concerns with this approach? How would you design a training program and define "simple check-ins" appropriate for cross-trained staff versus situations that require experienced front desk personnel? What standard work and error-proofing mechanisms would you build into this process?

3. Pre-assigning rooms at 2 PM on arrival day improved efficiency but reduced flexibility. What challenges might this create when guests arrive early and request their room, or when guests with specific preferences (such as a high floor or being away from the elevator) find that their pre-assigned room doesn't meet their expectations? How would you balance the efficiency gains from pre-assignment with the flexibility to accommodate guest requests? Design a decision rule framework for when to override pre-assignments.