MITLGO

LEADERS FOR GLOBAL OPERATIONS

LGO Class of 2024
Fall Research Showcase
Use Case Summaries

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LGO Class of 2024
Fall Research Showcase
Use Case Summary Book

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Fleet Standardization

AMERICAN INDUSTRIAL PARTNERS

BUSINESS PROBLEM

RelaOyne, a major lubricant and fuel distributor with 88 U.S. sites, faces challenges from its 450-truck fleet, diversified across 20+ types due to acquisitions. This mix burdens delivery coordination and amplifies upkeep costs. Objective: Elevate truck operation to amplify gallons/route and advise on truck selection to streamline fleet for economical dispatch and service. With a $60 million 5-year investment plan, the project must guide this capital to rejuvenate the fleet efficiently.

APPROACH

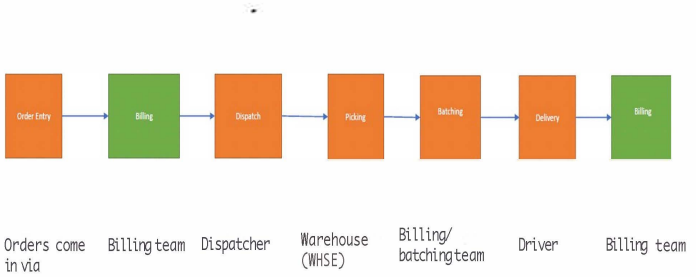
A detailed fleet and demand analysis was conducted across key warehouses. Over 150 hours were spent shadowing deliveries in diverse markets to understand the nuances. Direct interviews with drivers, dispatchers, and warehouse teams provided frontline insights. A comprehensive cost evaluation was done based on route and truck type. From these findings, an optimization model for demand-truck route m

DATA SOURCES

Information was gathered on demand profiles (product volume and revenue), delivery routes, truck specifications, ownership costs, uptime, drive/stop durations, maintenance and fuel expenses, service types, and the previous year's financials. This data, sourced from internal logs and financial statements, provided a comprehensive view of RelaDyne's operations for the optimization endeavor.

Data Types and Format

Data was primarily in Excel spreadsheets and Tableau, with route tracking information sourced from the Samsara website.



Author: Alexander Adelabu

IMPACT

The optimization model transforms RelaDyne's delivery planning. Instead of manual truck selection, dispatchers input data, and the model yields efficient routes, optimizing costs and time. It also minimizes the number of times customers are visited per week. This process bolsters the 'gallons per route' metric, indicating enhanced delivery efficiency and promising cost savings. The time studies on deliveries have further influenced truck feature choices particularly on trucks that can deliver all of RelaDyne's product types. By understanding real-world delivery challenges, there's a renewed emphasis on trucks that maximize driver safety, minimize wasteful movements, and provide dispatch flexibility. This model's insights are also instrumental for future fleet investments. With RelaDyne's planned $60 million investment over five years, the model offers a data-backed guide on optimizing these funds, be it in new truck acquisitions or feature enhancements. In sum, this approach not only delivers immediate operational advantages but positions RelaDyne for streamlined growth, with informed decisions and amplified efficiency across its extensive network.

DRIVERS	**Rapid growth and fleet diversification at RelaDyne led to logistical challenges. The company's push for efficiency and cost-effectiveness drove the need for an optimized delivery system.**
BARRIERS	**Data from varied sources, especially different ERP systems, made consolidation tough. Diverse truck specs and catering to different customer types and locations hindered a single solution approach. Gaps in historical data affected trend analysis. Budget and time limits constrained fleet enhancements and smooth transitions.**
ENABLERS	**RelaDyne's extensive data and a dedicated team of dispatchers and drivers, open to discussing daily delivery challenges, laid the groundwork.**
ACTIONS	**An optimization model was developed after analyzing fleet, demand, and route data. This model automated truck selection and route planning. Over 150 hours were spent on truck rides to gauge how truck type influences driver safety, deliveries, and customer satisfaction.**
INNOVATION	**The multi-compartment vehicle routing model, integrating demand for diverse products, truck details, and route effectiveness, was groundbreaking in refining RelaDyne's deliveries.**
IMPROVEMENT	**The approach boosted the 'gallons per route' figure, enhanced truck use efficiency, reduced stop durations at client locations, and steered fleet investment insights.**
BEST PRACTICES	**Gather robust data, grasp real-world delivery issues, and frequently test the model for effective replication.**
OTHER APPLICATIONS	**The method suits any multi-product, multi-compartment distribution industry, from food to e-commerce to pharmaceuticals, emphasizing route and delivery efficiency.**

Supply chain planning and inventory management | Retail | Network optimization | Network analysis

Digital Twin-Driven Supply Chain Enhancement to Suppport D2C Growth

BUSINESS PROBLEM

Nike is transitioning its supply chain from wholesale to direct-to-consumer to meet changing customer expectations of cost and service. However, the current distribution system, designed for wholesale, struggles to handle the growing volume of digital orders efficiently. To address this, Nike is adding new physical and digital capabilities, but it's uncertain how these changes will affect the targets defined by supply chain leadership. The project has a dual purpose: first, to create a critical module for digital twin of Nike's supply chain (focus on new capabilities), and second, to find ways to enhance performance of the updated network.

APPROACH

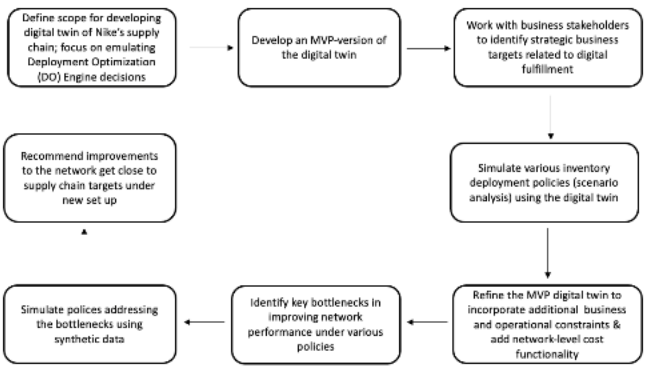
A digital twin of Nike' supply chain distribution was created, with a focus on replicating the new physical nodes and digital capability. Using the digital twin, various inventory deployment policies were tested to identify key bottlenecks. Lastly, policies with synthetic data that addressed these bottlenecks were simulated to measure the financial benefits of these improvements.

DATA SOURCES

Demand Forecast, Purchase Orders, Actual Sales, Inventory Levels, Shipping & Processing Costs

Data Types and Format

Numeric, structured data

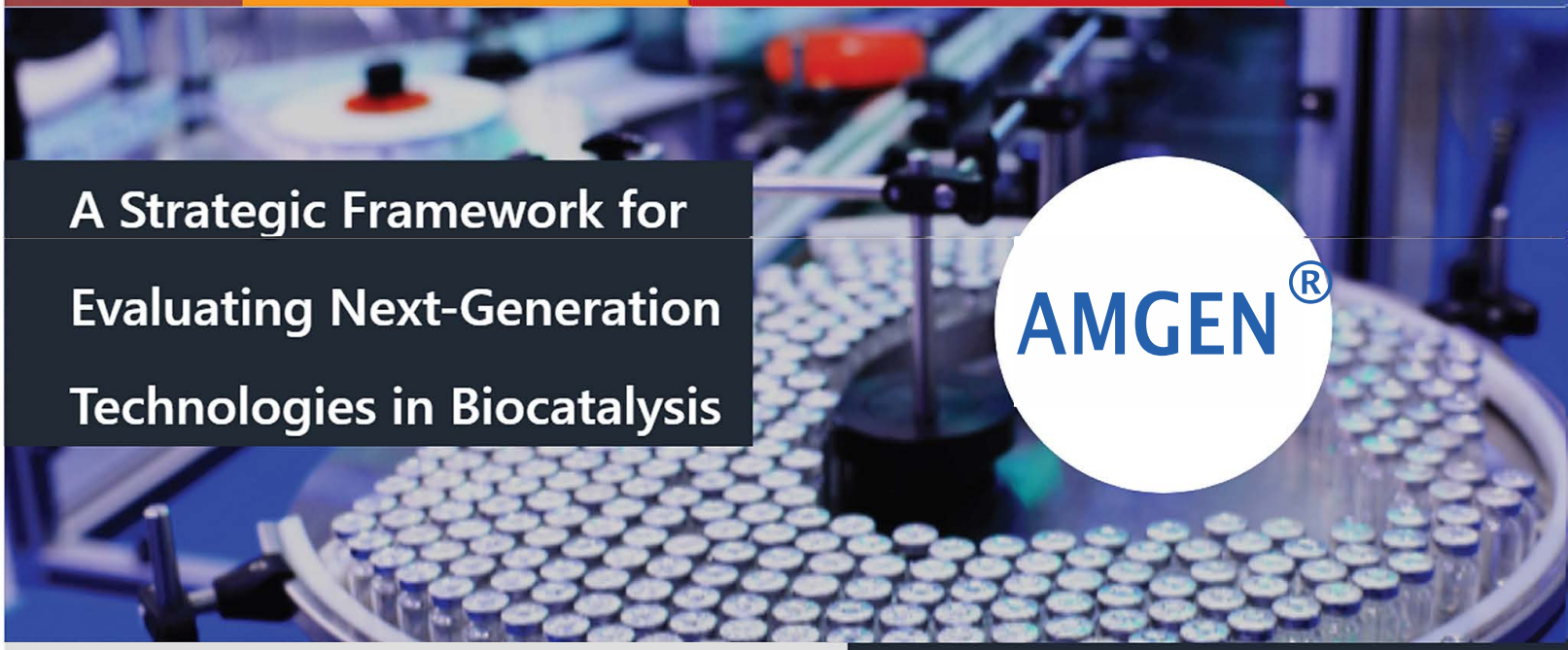


Author: Sid Agrawal

IMPACT

The digital twin offers Nike the ability to simulate various inventory deployment policies within the updated supply chain network, analyzing their impact on key metrics. It also facilitates cost savings assessment for various policies. Additionally, simulation results with synthetic data addressing forecast coverage and lumpy supply challenges have sparked evidence-driven discussions with supply chain partners to tackle these bottlenecks. In summary, the digital twin tool along with the synthetic data exercise has equipped Nike with insights and capabilities needed to get closer to the supply chain targets set by the leadership for supporting D2C growth.

DRIVERS	**DTC sales are a rapidly growing revenue stream for Nike and the broader retail industry. Consequently, there is a strong push within the company to enhance digital and physical supply chain capabilities to fuel D2C expansion.**
BARRIERS	**The North Star targets set for digital fulfillment were incredibly ambitious, to the point where their feasibility was in question. The project's open-ended nature and the difficulties in obtaining dependable historical forecast data posed obstacles.**
ENABLERS	**The cutting-edge software development infrastructure, which included AWS SageMaker, SnowFlake database, Git, and Jira, coupled with the support of a proficient data science team and cooperative business counterparts, played a pivotal role in facilitating the success of my project.**
ACTIONS	**I gathered empirical evidence illustrating the potential financial gains from my proposed solution and delivered these findings to senior leadership, including VPs and Directors from the supply chain analytics and logistics teams. As a result, Nike has commissioned additional work to delve deeper into the solutions I suggested.**
INNOVATION	**I created a highly granular digital twin that can be employed to research various supply chain network performance issues. Additionally, the use of synthetic data to tackle forecast coverage gaps and supply irregularities has paved the way for its broader application in cases where necessary data is unavailable.**
IMPROVEMENT	**The simulation results prevented a costly multi-million dollar investment in a cross-dock facility that would have failed to deliver the anticipated benefits. Additionally, the simulation with synthetic data revealed that resolving identified bottlenecks could triple network performance, measured by the % of inventory bypassing the primary distribution center, and simultaneously cut distribution/storage costs by millions of dollars.**
BEST PRACTICES	**When constructing a digital twin, it's more manageable to commence with a Minimum Viable Product (MVP) and progressively incorporate greater complexity, such as business and operational constraints. In conducting cost scenario analysis, it's crucial to maintain a consistent total product volume flowing through the network across scenarios to guarantee a fair comparison of network costs.**
OTHER APPLICATIONS	**The digital twin concept I implemented for distribution has the potential to expand its scope to encompass production and planning, as well as studies focused on sustainability within supply chains.**



A Strategic Framework for Evaluating Next-Generation Technologies in Biocatalysis

AMGEN®

BUSINESS PROBLEM

The emergence of a new wave of biocatalysis innovation is rapidly transforming the pharmaceutical industry. This next generation of techniques is reshaping approaches to process development for companies operating in this space. However, significant challenges exist in fully harnessing the potential of this new technology due to limitations in internal capabilities, including time constraints and knowledge gaps. To overcome these obstacles and unlock the true potential of biocatalysis. Amgen must strategically leverage external supply organizations to tap into the next wave of biocatalysis innovation and bridge its existing capability gaps.

APPROACH

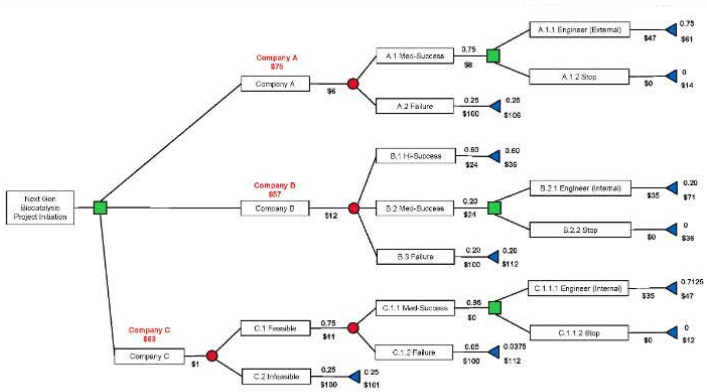
A funnel-like scheme with increasing complexity was used to gradually screen potential CDMOs. First, the framework organized around methods for selection and verification of a CDMO's background. Next, the focus was on identifying down selection criteria. And last, the framework presented the application of real options analysis to final CDMO selection.

DATA SOURCES

Technical information on the state of the biocatalysis industry was sourced from published literature, capability interviews, and market research databases. COMO-specific information was sourced from publicly available reports as well as proprietary information gathered from requests for proposals and company interviews.

Data Types and Format

Interviews (surveys, notes, audio); Requests for Information/Proposal (Excel files, Word files, PowerPoint presentations); Market Research Reports (online databases, video)



Author: Alec Creta

IMPACT

This project provided a comprehensive framework for the site selection of a next-generation technology contract development and manufacturing organization (COMO) in biocatalysis, with the potential for adaptation to various pipeline or emerging technology selection processes. The integration of site evaluation methods, decision assessment, and real options analysis within this framework effectively demonstrated an approach that enhanced the technical and financial accuracy of pre-pivotal development and manufacturing engagements. Following the establishment of the framework, the project successfully demonstrated the capability to conduct thorough preliminary investigation prior to engaging with CDMOs directly. And, the successful application of real options analysis led to the recommendation and implementation of a new operating procedure for early-phase biocatalysis work at Amgen.

DRIVERS	The pharmaceutical industry is facing a rapidly changing landscape, driven by technological advancements and evolving patient needs. As a consequence, the industry must remain agile in the adoption of innovation and sustainable practices to continue providing effective and accessible treatments to patients. Advanced biocatalysis techniques are seen as enabling, innovative, and sustainable solutions that play a crucial role in this pursuit.
BARRIERS	Amgen has a history of partnering with CDMOs on process and capability expansions. Nevertheless, the emerging technology space presents a new challenge where Amgen may lack the required expertise, necessitating a collaboration with an external partner to fill the gap. The limited internal knowledge and urgency to act quickly can become significant barriers in selecting and partnering with the right CDMO at the right price.
ENABLERS	Cross-functional collaboration and dialogue among the process development, strategic sourcing, contract development and manufacturing, and portfolio strategy and management groups served as a key enabler, providing the space to experiment with diverse methods.
ACTIONS	The framework utilized market analysis, stakeholder interviews, organizational analysis, decision matrices, CDMO outreach, and cross-company benchmarking. The final recommendation was based on a quantifiable comparison and optimization of the primary implications related to cost, technology, and intellectual property for each option.
INNOVATION	The application of quantitative analysis, including real options analysis and Monte Carlo simulation, provided a new level of objectivity to the emerging technology site selection. As a result, the site selection process highlighted the risks and opportunities associated with each option and enabled stakeholders to maximize the chances of success.
IMPROVEMENT	This project showcased the benefits of employing simple, user-friendly tools for quantitative analysis. By doing so, the approach effectively de-risked the upfront investment in an emerging technology and enabled a smooth entry into the space, earning senior leadership's increased confidence in the decision-making process. While also refining existing process development practices, enhancing overall efficiency.
BEST PRACTICES	Identify known unknowns, systematically measure uncertainty, and consider multiple outcomes using the framework. Optimize decision-making by focusing on challenging assumptions and employing risk management strategies. Share insights and learnings across stakeholders, and adapt the framework to suit a project's specific context.
OTHER APPLICATIONS	This framework is suited for projects with uncertain outcomes and potential changes in value over time. It is particularly effective for projects involving phased investments, levels of outcome uncertainty, and inherent risks of failure. This can include drug development projects, manufacturing facility expansions, and technology implementations.

Production | Industrial automation | Improved process performance | Rules-based

Automated Nesting for Throughput Improvement in High Mix-Low Volume (HMLV) Manufacturing

BUSINESS PROBLEM

Re:Build Cutting Dynamics inc. (CDI) is a site capable of sheet metal fabrication for aerospace and defense parts. To maximize material use when cutting parts out of material, CDI batches jobs which use the same material on sheets before cutting them with lasers, water jets, and routers. This job of determining which jobs to batch together and laying them out in an efficient manner currently requires significant manual work which increases lead times, reduces throughput, and reduces flexibility. CDI needs to increase the speed of nesting to keep up with significant growth expected in the coming years.

APPROACH

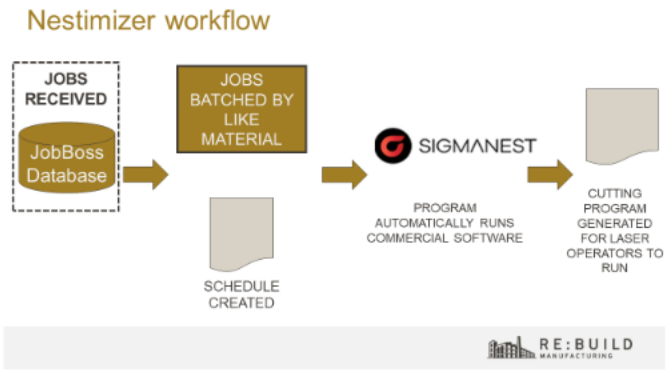
This project used process flow analysis to determine opportunities for automation within the nesting process. The project involved understanding and navigating tradeoffs between user input and automation in a HMLV shop by creating a Python program to automate collection of job information from databases and operators to write scripts that run commercial nesting software instantly.

DATA SOURCES

This project used data from the Enterprise Resource Planner (ERP) on numbers of jobs completed at each machine to get throughput estimations. Time studies were conducted to estimate how long jobs took generally and specifically how long nesting took. Further interviews were conducted with operators and management to understand how delays in nesting affect production operationally and financially.

Data Types and Format

Numerical data, text transcriptions of interviews.



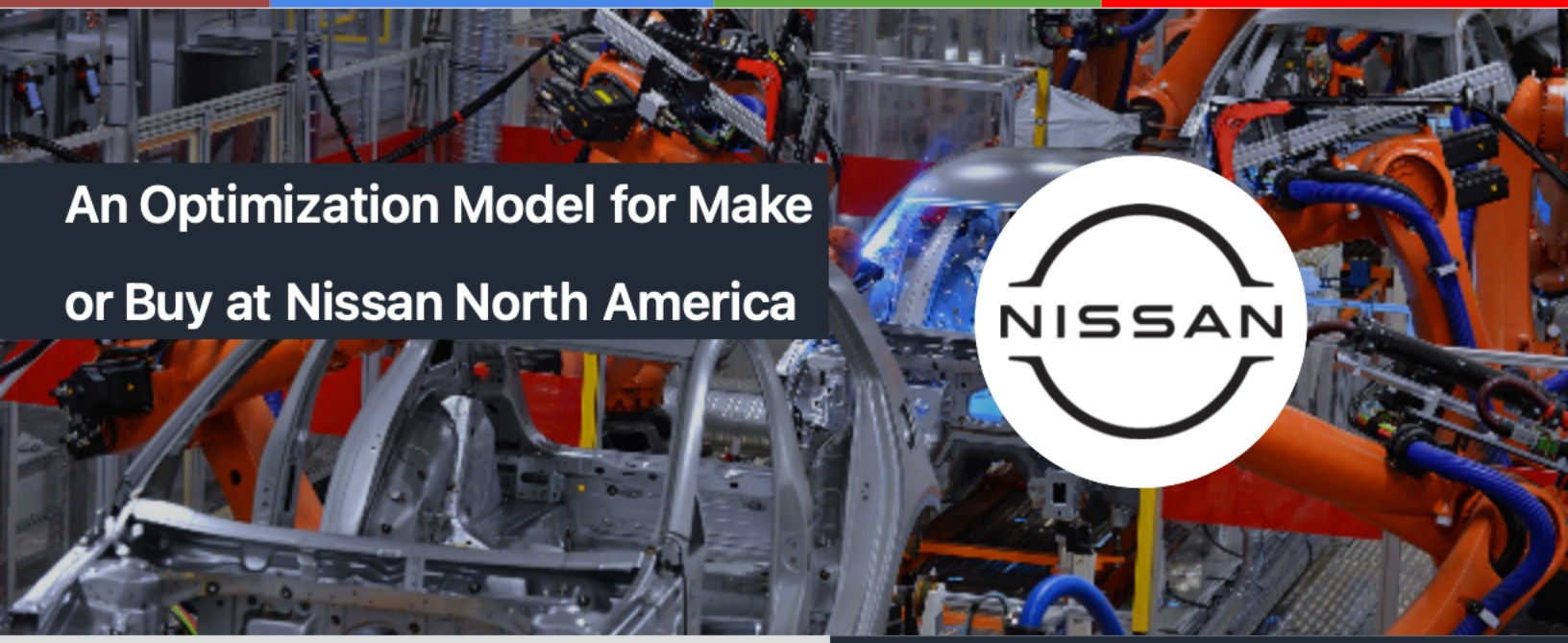
Author: Alex Davis

IMPACT

This project significantly reduced the amount of time it takes to batch and nest jobs properly, saving hours of time for several critical stakeholders and is projected to result in over $50,000 in throughput and $32,000 in material savings annually. Machine programmers at CDI are capable of nesting and re-nesting parts within minutes whereas the previous technique took hours to nest several together. This not only significantly reduces the lead time from job received to job ready to cut, but also makes the manufacturing system as a whole much more responsive to change. Whenever customer or production requirements cause a change, the work centers are able to respond with minimal effort. Additionally, the increased automation makes it easier for new people to learn how to program machines without a lengthy train up on nesting software. This makes the skill more democratized and will allow for people with the correct information (material handlers, laser operators, etc.) to program the lasers rather than a separate person that is more separated from the physical process. Finally, in the spirit of Re:Build's Lean Operating System and Lean operations in general, the extra time that has been freed up for the laser programmer can now be used to up-skill and increase his education so that they can work on other automation projects throughout CDI. This will allow the improvement efforts here to "snowball" into further successful improvement projects later.

DRIVERS	Placeholder
BARRIERS	Placeholder
ENABLERS	Placeholder
ACTIONS	Placeholder
INNOVATION	Placeholder
IMPROVEMENT	Placeholder
BEST PRACTICES	Placeholder
OTHER APPLICATIONS	Placeholder

Operations | Automobile manufacturing | Network optimization | Constrained / Unconstrained



An Optimization Model for Make or Buy at Nissan North America

BUSINESS PROBLEM

Nissan is strategically charting a path to optimize the utilization of their production assets in response to supplier disruptions to their past model service division and anticipated shifts to their operational landscape due to the introduction of EVs. Resolutions to these challenges involve in-sourcing more parts to remain competitive and introduce make or buy trade-offs between 2 core businesses: future model production and past model service production. Historically, these business units have operated independently, but there is a call to unite the two and strike a balance between in-house production and outsourcing.

APPROACH

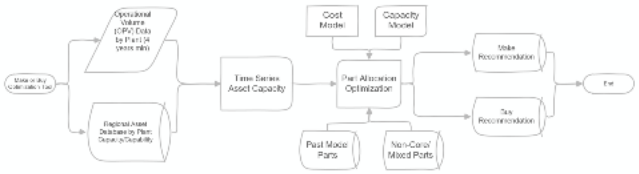
The proposed solution encompasses a mixed-integer optimization model driven to minimize the cost of producing a set of assemblies or individual parts, weighing each buy scenario and all internal make scenarios, subject to regional asset capacities to determine the optimal production scenario. This approach ensures all potential production scenarios are explored.

DATA SOURCES

Data sources spanned multiple business units and functions. Design data for parts/assemblies from new model engineering, cost data from costing/pricing/logistics groups, capacity data from production engineering in each plant, and vehicle demand data from industrial strategy.

Data Types and Format

Data Types are numerical or categorical. Capacity and demand information are time series. The remaining data are numerical or categorical and describe a part's/asset's attributes or cost metrics.



Author: Branden Francis

IMPACT

The impact of this project is three-fold. First, the model allows the business to perform feasibility studies before committing to an in-depth make or buy study of a production scenario for a part or assembly. Currently, effort may be expended studying a part or assembly that ends up not being cost competitive to in-house or that the business does not have capacity for. A positive externality of the research was gathering information on key inputs from other groups, such as a pricing/costing, engineering, and logistics, and replicating their calculations in the model. This significantly cuts down on the turnaround time for those inputs and allows the strategy group to focus on requesting information from supporting groups for competitive cost studies only. Secondly, the model allows the business to simulate different operational scenarios, which is a critical capability for the strategy group. Volumes, start/end of production dates, costs, assets, shift patterns, etc. that are input into the model can be adjusted and the subsequent make or buy decisions determined. Finally, this approach allows the business to holistically and exhaustively evaluate all production scenarios to discover potential cost savings – an activity that would that would be time prohibitive to pursue under the current make or buy workstream. Overall, the aim of this project is to determine optimal make or buy production scenarios, discover cost savings, and simulate different operational landscapes.

DRIVERS

The anticipation of an increased focus on in-sourcing more assemblies and parts across different models/verticals to be more cost competitive lead to the need for a more holistic and efficient method of determining which parts to insource or outsource.

BARRIERS

Working with design information that is 3+ years upstream of production and operational data projected 7+ years into the future means there can often be gaps/low confidence in an assembly's or plant's "dataset". Having incomplete information on can produce an optimal solution that may not reflect reality.

ENABLERS

The data science and analytics teams were particularly helpful in getting the project started from a technical point of view. Given the breadth of the project, key stakeholders from the supporting groups of the make or buy workstream were enthusiastic about providing context around their contributions to the workstream.

ACTIONS

Made it as easy as possible to use the model through Python and provided a manual with instructions on how to install the necessary programs and how the model reads information from Excel.

INNOVATION

This solution/model was developed using open-source optimization solver in Python and reads data from a commonly used spreadsheet editor, enabling large scale optimization, scalability, and lowers a barrier of entry for other groups to use this tool.

IMPROVEMENT

This provided the Industrial strategy team the ability to efficiently approximate costs, generate make or buy recommendations without relying on inputs from multiple teams, and identify cost optimal production scenarios. It allows them to simulate different operational scenarios with ease.

BEST PRACTICES

When dealing with projects that draw information from international teams, make sure to test, question, and compare any assumptions or information derived from other countries. One can discover key operational differences that may impact the model's output.

OTHER APPLICATIONS

Putting aside the optimization aspect, a model of regional assets, labor/logistics rates, and vehicle demand can be used to simulate many different operational scenarios a business may want to explore. Any input in the model can serve as a lever to examine how key outputs impact operational and financial metrics.

Optimizing thermoplastic composites manufacturing with digital process intelligence

BUSINESS PROBLEM

Oribi Composites is a thermoplastic composite manufacturing company specializing in the production of medium-volume thermoformed products. Such high-draw composite thermoforming is a challenging process unique to Oribi. To date, process parameters have been developed through learned experience and trial & error, with limited understanding of the underlying drivers of material behavior or product quality. As a result, yields for some products reach as low as 60-70%, and as the company looks to scale, improved process insight and control is critical to tightening product development times and reducing costs.

DATA SOURCES

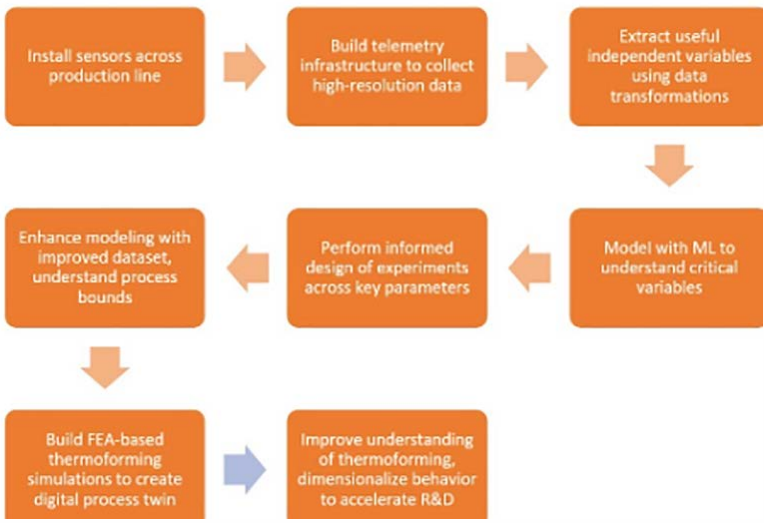
This project included end-to-end data source creation and connectivity. Process sensors including temperature, pressure, current, flow, and environmental sensors were installed across the manufacturing line. Additional digital data sources such as infrared imagery were installed, with all sensors streaming through a custom telemetry system to AWS data lake and accessed via SOL.

Data Types and Format

Primary numerical data sources were streamed in a time-series format at 1-lOOHz, depending on data needs. Triggered data collection was also implemented, including FUR imagery and traceability data.

APPROACH

A suite of process and environmental sensors were installed across the manufacturing line to capture high-resolution data of the production process. In parallel, a telemetry & database infrastructure was built to stream this data and enable machine-learning based analysis. Leveraging those insights, targeted experiments were performed to understand drivers of quality and composite properties.



Author: Evan Haas

IMPACT

Leveraging this high-resolution data and the series of experiments it enabled, scrap rates for the target product were sustainably reduced by 6X. This robust data telemetry infrastructure also provides the foundation for a scalable, multi-site digital backbone that will become the core to a machine intelligence program at Re:Build.

DRIVERS	Polymer composites are finding an increasing number of applications across industries like aerospace, automotive, sporting goods, and medical devices. However, traditional thermoset composites are expensive and slow to manufacture, increasing component cost. Thermoplastic composites have the potential to change this paradigm by enabling legacy high-volume methods of manufacturing like thermoforming to this industry.
BARRIERS	Oribi's deep-draw processes are highly unique in the industry, so little research has been done in the field around the properties that drive product quality, material behavior, or optimal process parameters. This challenge is compounded by the lack of documentation and experimental rigor in the culture at Oribi, which meant this project had to be built from the ground up in conjunction with a cultural shift towards science-first design.
ENABLERS	A culture of rapid change, engineering-led management, and strong executive support were all essential enablers of this process.
ACTIONS	This project involved the buildup of a data collection suite from the ground up. First, an initial suite of sensors were selected and installed across the production line. In parallel, a telemetry infrastructure and database system were built to send and receive this data. Finally, these systems were tied to a pre-processing suite and modeling software to extract valuable insights across a series of targeted experiments.
INNOVATION	The success of this project depended on multi-model data collection. Tying data from continuous, time-series, quantitative sensors such as time or coolant flow to triggered data capture such as infrared imagery was a critical enabler in distinguishing correlation and causation across process parameters.
IMPROVEMENT	The target product improved from a ~60-70% average production yield to a repeatable 95%+ over the course of the project. In addition, it built a scalable data pipeline for deployment across future sites.
BEST PRACTICES	Adopting a broad, agnostic approach when tackling a novel question is critical to avoiding bias in the selection of sensors and modeling parameters. Avoiding inbuilt assumptions about the factors that were critical to the process enabled us to identify unexpected errors and correlations in our manufacturing processes.
OTHER APPLICATIONS	Such a system can be deployed across any manufacturing or experimentation line to better understand the correlation between process and environmental parameters with outcomes. Additionally, such a system should be core to any SPC or quality control program.

Scheduling in a High-Mix Low-Volume Job Shop

LFMcapital

BUSINESS PROBLEM

Rainier focuses on customer-specified, made-to-order products consisting of four different business lines. These lines share graphics, fabric, wood, and metal production shops. The challenge lies in predicting shop utilization due to varied custom jobs, with each job potentially involving multiple shops and resources. Complexity increases as jobs require different processes, machines, and resources. Without an effective scheduling system, delays and inefficiencies can disrupt on-time delivery and customer satisfaction. Establishing an efficient scheduling strategy and tool is vital for success in this high-mix low-volume shop.

APPROACH

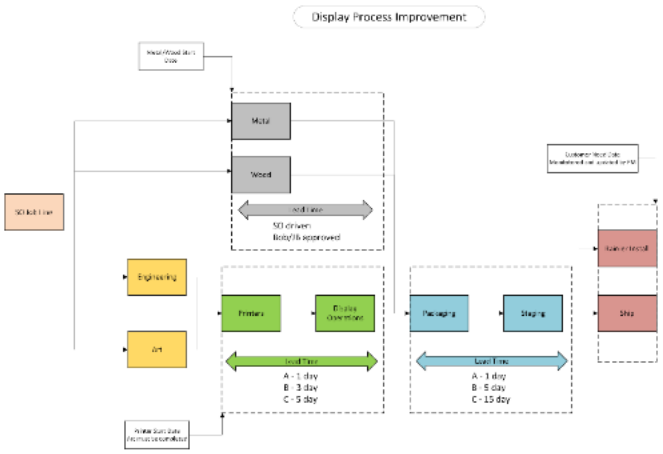
The project started by modeling the scheduling tool from one that is used by another LFM PortCo. The approach was to build a scheduling tool within the ERP system that could be updated to establish the production schedule and then hold biweekly meetings to update the schedule. Through this process we were able to identify what worked well and what needed to be improved on or changed completely.

DATA SOURCES

The data for this project was sourced from the companies ERP system, Epicor. The data was obtained through OData queries through the Epicor platform. It included data such as the due dates, completion dates, customer names, rework, estimated hours and actual hours for all operations on each job.

Data Types and Format

The data used was simple tabular data. It was pulled from the Epicor system into Power BI and Excel as simple data including columns with numeric data, text data, boolean data etc.



Author: Nick Holmes

IMPACT

The impact this project has on the business is a comprehensive process and tool that can be utilized in a high-mix low-volume job shop to improve overall production scheduling. The initial model adapted from the other portfolio company proved to not be useful in the Rainier production process. It became clear through the biweekly meetings and analyzing the company data, which led to a new process where key business rule changes were identified that would provide value to the business. The updated process and tool will be able to schedule jobs effectively and efficiently on a regular basis by prioritizing production based on profitability, customer needs, and the efficient utilization of capacity. This will grant stakeholders control over production decisions, enhancing visibility and tracking of scheduled versus completed tasks. Additionally, the project addresses inefficiencies introduced by the scheduling process and finds opportunities to improve the flow of products within the system. The implementation of this enhanced scheduling process will enable Rainier to minimize bottlenecks, reduce production delays, and ultimately enhance on-time delivery and customer satisfaction. The project also provides visibility into the company's data and allows real time knowledge of what is happening on the production floor.

DRIVERS

The driver for this solution was the need to stay competitive and win more business for the company. Rainier ultimately wants to be able to drive higher revenue and serve more customers and need the consistency in their production process to be able to accomplish that.

BARRIERS

One key barrier faced during the project was buy in from the shop floor managers on the implementation of the process and tool. A few key managers were skeptical of the change and stubborn to buying into the iterative process that would lead to more effective scheduling. Another barrier came during spikes in demand that led to everyone being extremely busy, with little time and motivation to invest in the process change.

ENABLERS

The leadership team at Rainier were all very supportive of the project and wanted it to be successful. They understood the implications of how it could affect the overall business. The LFM Capital team as well were very invested in the success of Rainier and therefore played a key role of ensuring the project got the light it needed in order to be successful.

ACTIONS

One main action taken to implement the solution was to develop the tool within the ERP system that could be used to update the schedule. Another action was to analyze their data to understand where they were having issues and how a scheduling tool could be of use to increase efficiency. A third action was to identify key areas where business rules needed to be implemented to provide more discipline in their production process.

INNOVATION

One key innovative aspect was the use of Power BI dashboards. The data at Rainier is very accessible but not understood or visible to the shop floor. My solution provided dashboards that would show real time insights into what was available to work on the shop floor and areas that might be at or above capacity. Being able to see and interpret the data will have a long term impact on how the shop floor should be run.

IMPROVEMENT

The overall final improvement the solution provides is standard lead times and ship-by dates that can be trusted by the managers and operators on the shop floor. This will provide a clear path for the scheduling team by allowing them to only focus on scheduling the work at the printers based on the capacities of each resource in the shop. It will also lead to consistent on-time delivery.

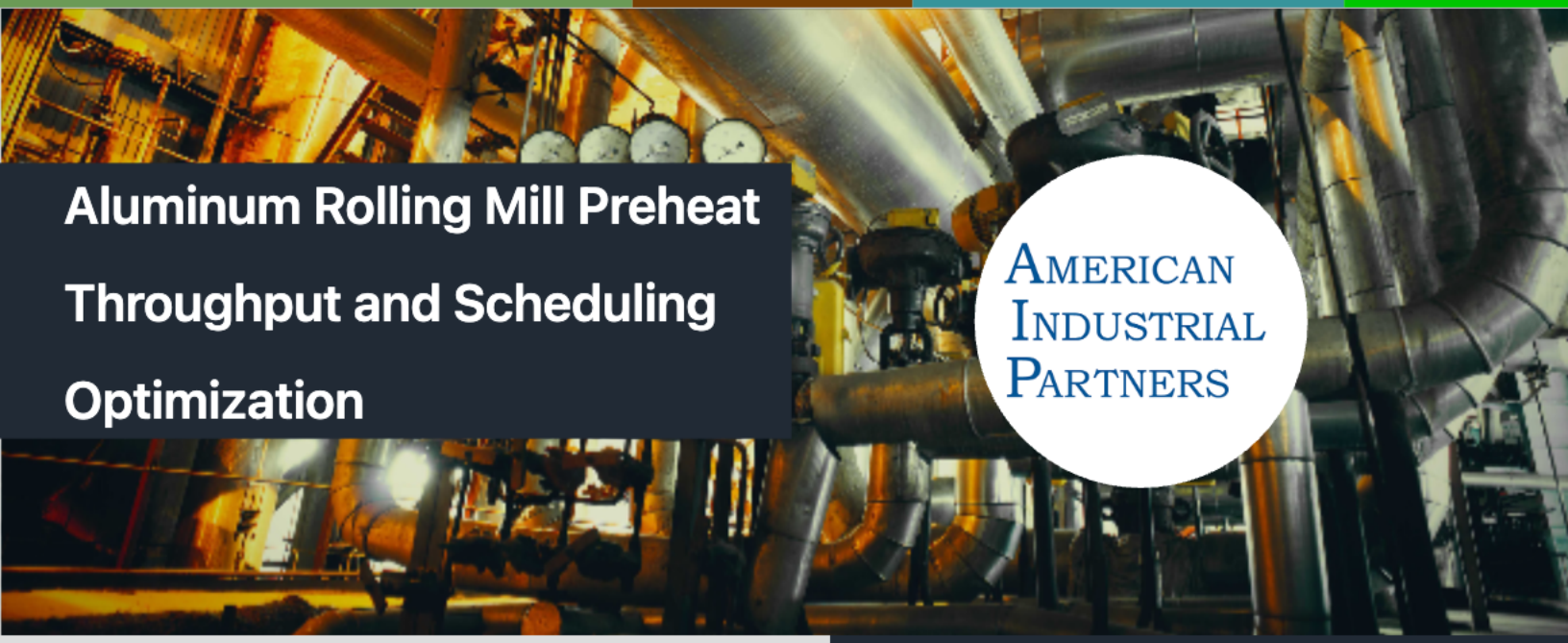
BEST PRACTICES

The key is to understand what step in the production process is causing the biggest pain points to the production floor. In this project, major problems on the shop floor were a result of issues on the front end of the sales, order entry and art department. These problems flowed down stream to the shop floor resulting in inefficiencies and production mishaps.

OTHER APPLICATIONS

Applications of this process can be applied to any job shop dealing with high-mix low-volume production regardless of the product.

Supply chain planning and inventory management | Plant engineering | Improved process performance | Rules-based



Aluminum Rolling Mill Preheat Throughput and Scheduling Optimization

American Industrial Partners

BUSINESS PROBLEM

Commonwealth Rolled Products (CRP), an aluminum rolling mill and a portfolio company of American Industrial Partners (AIP), is undergoing a transformation which includes a significant volume increase. Although many of the mill's processes have been thoroughly studied and CRP is confident that they can support this volume increase, CRP has only a limited understanding of the capacity of the preheat process, which heats metal before it is rolled. By building on initial work and developing a more nuanced understanding of the process' capabilities, we will determine whether the preheats can support the operating agenda and act on the results.

APPROACH

Phase I of my internship sought to determine current-state utilization through research and analysis. Finding that preheats were a potential mix-dependent bottleneck, I pursued two tracks in parallel: 1) operational initiatives to increase preheat throughput and 2) scheduling optimization to ease material flow throughout the mill.

DATA SOURCES

From the supply chain team, weekly sales forecast by product. From the master CRP database, product-asset matching rules and process characteristics. From the hot line team, process runtimes by product and asset, downstream process metrics, and maintenance history. From others in the organization, 2022 actuals for back-testing,

Data Types and Format

Data at Commonwealth exists in three primary forms: 1) Standardized processes (SMPs), 2) Living Excel spreadsheets, 3) Institutional memory.

Author: Evan Long

IMPACT

CRP consists of six sequential processes, meaning that each must be capable of supporting sufficient throughput to enable the overall goal. The other five processes have been well studied and CRP is confident that they can deliver that goal. However, without a thorough understanding of preheat capacity, the future goal may be in jeopardy. This project therefore has two immediate impacts. First, the initial capacity analysis determined whether significant additional capital investment was needed to increase preheat throughput. Second, follow-on efforts maximized the value of the existing asset base and enabled initiatives in other parts of the plant.

DRIVERS

Over the last three years, CRP has achieved significant operational improvements throughout the mill. These improvements created the opportunity to meaningfully increase production and shift the product mix to be more favorable for the business. The pre-heats need to be more thoroughly evaluated to ensure they will not become a capacity constraint in the future volume / mix scenarios.

BARRIERS

The process was mathematically complex, so finding a balance between fidelity and efficiency was critical. The preheats are made up of 14 different work cells, each of which has its own constraints on the products it can serve and different process times for the same product. Moreover, the preheats are a batch process, and each batch exits sequentially to the hot line.

ENABLERS

Easy access to the preheat plant itself, the process managers, and the supply chain team helped me access and contextualize information, as well as formulate and test hypotheses. Maximizing time onsite was key to developing the relationships and literacy needed for success.

ACTIONS

Two key analytical steps made the solution possible: 1)rationalizing the work cells and the products into categories of functionally homogenous members, 2)implementing a greedy heuristic, informed by best practices from the preheat managers, to assign products to work cells in our model.

INNOVATION

The solution was designed to fit easily into existing processes. Rather than being a standalone tool, it can be integrated directly into CRP's supply chain planning in order to ensure that future sales volumes and mixes will not run afoul of maximum preheat process capacity.

IMPROVEMENT

The solution shows that CRP does not need to buy an addtional tunnel furnace to achieve its goals.

BEST PRACTICES

Start from actuals, not projections. Familiarize yourself with known best practices in order to sense-check an optimization output or even incorporate heuristics to steer the model in the right direction. Ask whether any component of the is problem has been solved in the past, even in a very different context.

OTHER APPLICATIONS

This solution could be applied to any other industrial sequence where a set of parallel processes merge to a single chokepoint in the overall manufacturing flow.

Supply chain planning and inventory management | Healthcare / Pharmaceuticals | Inventory management / control | Supervised Learning

Machine Learning and Stochastic Simulation for inventory Management

BUSINESS PROBLEM

Raw material inventory levels have been climbing at Amgen and Amgen is currently holding circa $1bln worth of inventory, across all plants, with a clear opportunity to optimise inventory. There is a non-standard wav of estimating buffers/safetv stock for materials and many materials, even those with high resiliency have high inventory targets. The challenge includes finding a standardized way to optimally dimension optimal safety stock and reduce on-hand inventory while managing non-uniformly distributed demand and variability, supply disruptions/ risk and lead time variability, production and material defects, holding cost and expiry risk.

APPROACH

ML models were built to predict the lead time and the demand. For limited demand data, forecast accuracy was used to derive future demand. These output and their variance were feed into the safety stock formula. Service level was segmented for 10000+ raw materials and a monte-carlo simulation run on the safety stock, varying the lead time and demand. What-if analysis and optimisation also included

DATA SOURCES

Raw material data, finished drug product data, Revenue information, historical purchase order data, Supplier performance data, historical demand plan data, historical consumption data were required for this project. Most of the data can be currently found in SAP and Rapid Response, accessible via the Amgen Enterprise Data Lake.

Data Types and Format

Time series data, numerical and categorical Data in Databases and a few excel files.

Author: Ololade Olaleye

IMPACT

- The business can simulate risk tolerance settings to reduce inventory levels. This can lead to one-time delay in spend as well as year-over-year holding cost savings of up to 25% and even more, depending on management service level decisions. This also allows the company to free up working capital and reduce expiry risk and scrap disposal. - The company is also able to better manage the suppliers and facilitate better planning by being able to predict supplier performance and lead times. - The demand forecasting model helps to reduce forecast error in raw material inventory. - The solution is a standardized way of managing inventory by leveraging historical data across not just raw materials but other echelons, and other echelons can benefit from this methodology. - The segmentation framework and finished drug product mapping to raw materials helps the company better understand their inventory landscape and levels of risk across the chain. - The what-if/disruption framework helps the company plan and respond to other kinds of risks and external factors, and this enables decision making. - The overall framework will better the company's risk management for inventory.

DRIVERS

1. High inventory level ties up significant capital and can lead to wastage due to scrap disposal 2. Dynamic, data-driven systems mitigate effects of global supply chain challenges and disruptions 3. Competitive Edge 4. Digital Evolution: Leveraging AI and data analytics helps companies make more intelligent decisions 5. Sustainability: Reducing inventory waste promotes environmental responsibility 6. Amgen's mantra "Every Patient, Every Time"

BARRIERS

Data availability and credibility. Some of the data pipelines had some issues which made the progress and verification of the solution slower. This project relies heavily on credible data.

ENABLERS

Willingness to support the initiative and help source the data required. Alignment on the value of the project and with the raw material transformation workstream.

ACTIONS

I performed extensive research on available methods and approaches. I deconstructed the problem and created a methodology in steps. I interviewed a lot of key stakeholders for better understanding. I started building each step and tested many approaches and use resources in house to collate data required. I ran several test cases and compared my solution with what happened and the company methodology.

INNOVATION

It combines data-driven decisions, predictive analytics, probabilistic simulations, and optimization to address the complex and dynamic nature of inventory management. It utilizes bootstrapping to predict lead time variance. It also fits the demand during the lead time using a python package called fitter which ensures it doesn't assume a normal demand distribution. The solution also leverages multicriteria segmentation to properly correlate risk

IMPROVEMENT

The solution showed that the company can reduce inventory to the tune of hundreds of millions of dollars, up to 25% and more, depending on decisions on desired risk tolerance and avoid incurring additional cost in the future. It also ensured that we can plan with realistic supplier lead times and mitigate supply risk and variability.

BEST PRACTICES

Speak to key stakeholders and leverage connections/SMEs. Use lots of data and properly understand nuances in data and the problem. Build/Solve the problem in modules

OTHER APPLICATIONS

This solution is applicable and scalable at any echelon of supply chain and for any organization in any industry that has a supply chain and requires any form of inventory. It can also help mitigate supply disruptions and understand supplier performance better.

Greenhouse Gas Optimization Across a Multi-Echelon Manufacturing and Distribution Network

BUSINESS PROBLEM

Businesses across the world have begun to pledge reductions in Greenhouse Gas (GHG) emissions across their organizations to better preserve the planet. The host company has committed to a percentage reduction of its Scope 3 GHG emissions, which includes that of its outsourced multi-echelon manufacturing and distribution network. The task of optimally allocating supply amongst global production locations and transport modes while reducing GHGs, preserving low costs, and serving a global consumer base is beyond the human decision making capacity, and requires optimization technology in order to achieve viable results.

APPROACH

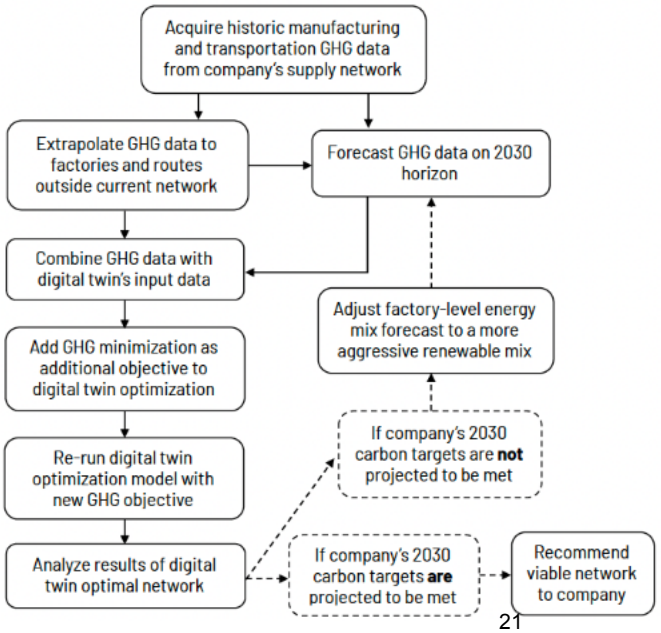
Historic manufacturing and transportation GHG data from the upstream network were acquired. Projections were developed to estimate emissions on a 2030 time horizon and for facilities that may join the manufacturing network by 2030. Projections were incorporated into a digital twin optimization model, set to optimize for GHGs, cost, risk, and lead time, then optimal networks were generated.

DATA SOURCES

Two database were used to access network historic GHG emissions information. One database contained an emission breakdown based on energy purchased and generated onsite at upstream manufacturing locations. The other database contained an emission breakdown based on historic transportation routes and modes within the upstream transportation network. Both databases were company internal reporting.

Data Types and Format

GHG emissions data were extracted from Snowflake tables and processed using Python.



Author: Theo Rosenzweig

IMPACT

In a time when emissions are of increasing importance, the supply plans produced using the GHG optimization algorithm will help the company do its part to reduce emissions to better preserve the planet. The host company has pledged to significantly reduce its Scope 3 GHG emissions by 2030 as informed by the Paris Agreement's guidelines, and it will take data-driven strategies to meet those aggressive targets. The optimization algorithm of focus in this project helps create optimized supply plans to meet the GHG reduction targets. The algorithm also helps find the lowest cost, lowest risk, and most responsive network solutions that can meet emission targets. The combination of these objectives makes the algorithm not only climate-centric but also savvy for business use.

DRIVERS

The Paris Agreement's goal to keep the increase in global average temperatures below 2 degrees celsius above pre-industrial levels was a major driver for the company's GHG reduction targets. These targets are the motive for the GHG optimization algorithm.

BARRIERS

The company had less manufacturing GHG related data in further removed tiers of the upstream supply chain than in near tiers of the supply chain. Due to these data gaps, the algorithm's accuracy was diminished when distant tiers were included in scope, which was a barrier when reviewing the exact network GHG values of the algorithm's solutions.

ENABLERS

The company was willing to share any available data to enable the creation of the optimization algorithm. Additionally, the company provided a strong mentorship support network from the first day of the internship, which helped the project flow smoothly. Employees were eager to implement solutions into their full-time practices, which made the project impactful on the long term scale.

ACTIONS

GHG emissions related to the production of goods at all in-scope manufacturing facilities were either directly extracted or extrapolated. GHG emissions from the transportation of materials and goods were calculated. All emissions information was fed into the optimization algorithm input stream with cost, risk, and lead time related data. An objective function was added to minimize network GHGs.

INNOVATION

The algorithm is innovative in that it allows for optimization of GHGs, cost, risk, and lead time together instead of limiting to sole optimization for GHGs. The multi-objective optimization quality makes the algorithm useful in business settings, so it can be used as more than a standalone tool for sustainability purposes.

IMPROVEMENT

The solution provides a supply plan that the company can follow to meet their 2030 GHG reduction targets, which was an unknown before commencement of the project.

BEST PRACTICES

Best practice is to ensure that adequate emissions-related data is available for every in-scope tier of the manufacturing and distribution network. If adequate data cannot be made available for a network tier, consider removing that tier from the optimization algorithm because it may obscure results.

OTHER APPLICATIONS

The GHG optimization strategy could be implemented in any manufacturing and distribution network, regardless of if the network is global or local, multi or single echelon, and regardless of the type of good manufactured. As long as there is adequate emissions-related data, the methodology behind the algorithm may be applied.

Logistics / Distribution | Healthcare / Pharmaceuticals | Improved process performance | Recommender Systems

Warehouse of the Future

BUSINESS PROBLEM

By 2026, the Amgen warehouse is expected to be affected by an increase of material, a centralized warehouse and an increase in competitive pressures to decrease cost. The goal of this project is to use organizational design and automation opportunities to help alleviate these concerns.

APPROACH

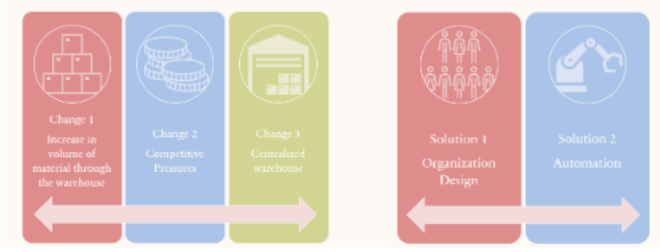
I used a standard work document and SAP data to calculate utilization for the different teams. I then projected the need for 2026. Trough conversations, I was able to understand the different shift structures used throughout the network. Finally, I worked with multiple vendors to understand the right automation fit for the warehouse as well as the costs to retrofit.

DATA SOURCES

SAP data, warehouse standard work

Data Types and Format

The majority of the data used was contained in excel spreadsheets



Author: Stephanie Severe

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

TBD

Product design / development / engineering | Aerospace and defense | Product design and testing | Tree-based

Framework for Enhancing Decision-Making Capabilities in the Decarbonization of the Airline Industry

BUSINESS PROBLEM

The path to executing on the airline industry's net-zero goals by 2050 remains nebulous, with sustainable aviation fuels (SAF), electrification, and liquid hydrogen (LH2) at nascent technology readiness levels. In order to mitigate risk, airline industry leaders may begin to rely upon decision-support systems (such as Cascade) to tackle uncertainty through scenario analysis, fleet replacement modeling, and techno-economic assessments. In other words, what strategic questions should airlines pose to successfully execute sustainability targets?

APPROACH

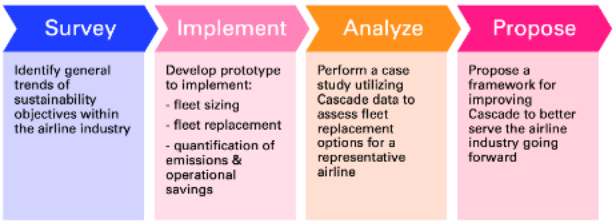
This project will evaluate pain points in airline fleet planning and alignment with sustainability targets in order to create a robust, repeatable method for airlines to assess tradeoffs between operational economics and carbon intensity of various fleet planning scenarios. The method was then implemented within Boeing's Cascade model framework and a case study was conducted to examine efficacy.

DATA SOURCES

Global flight traffic data: Cascade (FlightRadar24, Cirium) Airline fleet and network data: Wikipedia, PlaneSpotters

Data Types and Format

CSV files



Author: Allison Tsay

IMPACT

At present, Cascade relies on basic approximations for payload, flight trajectories, and adoption rates of alternative energy sources and future aircraft technologies. With the release of Cascade to the public in May 2023, the critical question remains as to how Cascade can be transformed from an educational tool into a high-precision, decision-support system for the airline industry. The proposed framework for improvement and resulting prototypes will serve to enhance the decision-making capabilities of Cascade and better serve the airline industry in achieving its net zero emissions goals. Thus, adding momentum in Cascade's evolution from a high-level educational tool to a more robust and granular decision-making system.

DRIVERS

While over 290 airlines have made pledges to fully decarbonize by 2050 (IATA), the path to executing on net-zero goals by 2050 remains nebulous at best. With that in mind, how should an airline approach making decisions about implementing or investing in sustainable aviation technologies? How can an airline leverage Cascade to make these decisions? How can Cascade be transformed from an educational tool into a high-precision, decision-system for

BARRIERS

Barriers to progress included data quality and availability of airline fleet data, proprietary release processes, change management, and lack of airline stakeholder input

ENABLERS

The combination of Boeing's technical expertise, collaboration with Aurora Flight Sciences for modeling advanced technologies, and access to industry insights and resources created a fertile ground for the successful development of this project.

ACTIONS

Survey of sustainability goals across the airline industry, comprehensive data collection and research into representative airline's fleet and network data for the case study, implementation of a prototype within Cascade for increased customization and specificity for airline emissions analysis, and documentation for integration into the web-app

INNOVATION

Innovative aspects of this solution include enhancing precision in emissions reduction strategies for the airlines.

IMPROVEMENT

The solution will transform Cascade into a precise decision-support system that optimizes flight operations, leveraging accurate data on payload, load factors, and route traffic growth. This enhancement will empower the airline industry to make informed, data-driven decisions using Cascade.

BEST PRACTICES

1. Robust Data Collection: Gather accurate and comprehensive data on flight operations, sustainability investments, and technology adoption. 2. In-depth understanding of the current Cascade architecture and technological roadmap

OTHER APPLICATIONS

Within Cascade, this solution can be extended to assist the airlines in planning for electrification and introduction of alternative energy sources. Beyond the airline industry, this data-driven decision fleet replacement framework could be adapted for sustainable operations in shipping, logistics, and transportation sectors.

Establishing Inventory Maturity in a Make-To-Order Manufacturing Environment

LFMcapital

BUSINESS PROBLEM

Accelevation LLC has grown very quickly from its beginning in 2018 via acquisitions and natural expansion. This growth in sales has not been perfectly followed by maturing processes. The lack of established inventory management policies to reduce stockout events and optimize costs presents an especially troublesome issue. The business historically purchased material based on jobs released to production and does not have strong forecasting abilities based on the make-to-order nature of the products. Additionally, physical counts of inventory on-hand often do not align with the amount of material in the enterprise resource planning system.

APPROACH

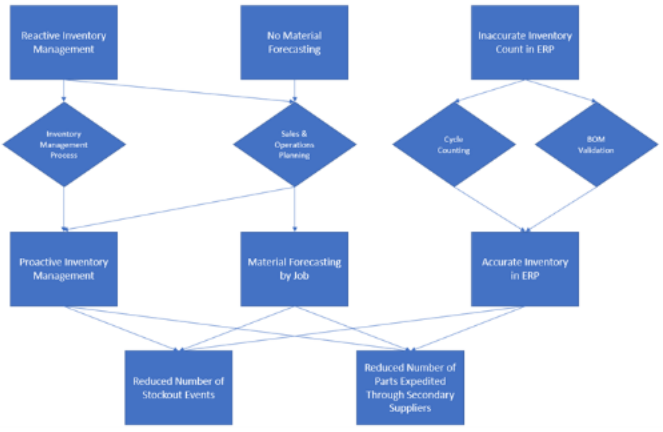
The research will be split into three correlated efforts. A basic re-order level and quantity inventory management policy will be put in place. Next, bill of material validation and material cycle counts will be introduced to improve inventory accuracy. Internal processes for material storage and consumption will also be reviewed. Finally, sales & operations planning will be implemented.

DATA SOURCES

TBD

Data Types and Format

TBD



Author: Adam Vignaroli

IMPACT

For growing make-to-order businesses, the quantities of materials that are consumed will continue to increase without being able to build finished product stock as buffer. As the supply chain complicates, stock-out events can become a nuisance and slow production. Processes in place also need to be robust to grow with the company's revenues and throughput without additional cost. The legacy processes in this project included manual purchase order quantities and timing with tracking occurring by the buyer's individual checks. With these existing processes, growth requires additional headcount to maintain similar levels of material effectiveness, with likely diminishing effectiveness among more complicated material consumption and orders. Enhancements to Accelevation's inventory management through policy, accuracy, and forecasting enhancements will allow for revenue growth with a less than directly proportional increase in operations support personnel. While the business continues to evolve and serve different aspects of the data center containment market, demand may deviate from historical usage. Processes that plan for these deviations from historical usage will allow Accelevation to plan material beyond their inventory policy for situations where they would otherwise be at risk of stock-out events. In all, creating robust inventory management processes will aid Accelevation's continued growth.

DRIVERS TBD

BARRIERS TBD

ENABLERS TBD

ACTIONS TBD

INNOVATION TBD

IMPROVEMENT TBD

BEST PRACTICES TBD

OTHER APPLICATIONS TBD

Paths to Achieving Scope 1 Carbon Neutrality in Building Utilities

BUSINESS PROBLEM

Amgen's carbon neutrality target is based on a three-pronged approach. The first is innovation to reduce the amount of energy required to develop and produce their medicines. The second is operational efficiency. The third is pursuing renewable energy to the fullest extent in the regions they operate. Only after innovation, efficiency, and renewable energy projects are implemented, decarbonization efforts such as carbon removals or high-quality carbon offsets are evaluated. This project investigated innovative solutions to permanently reduce Scope 1 emissions in building utilities while minimizing the use of carbon removals and offsets.

APPROACH

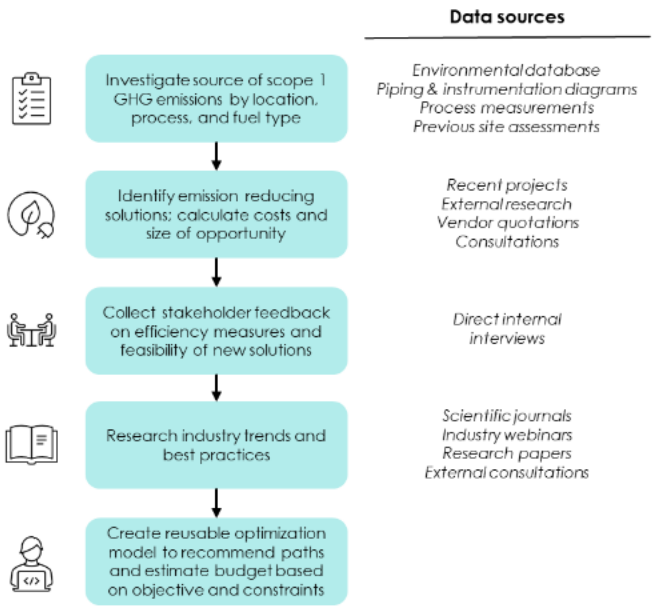
Information on energy demands of core business functions was gathered and mapped. Commercially available and emerging technologies were evaluated by their Scope 1 emission impact, cost, and feasibility. Stakeholders, such as site engineers, were interviewed to collect feedback and evaluate solutions. An optimization model was created to select projects to maximize NPV under varying constraints.

DATA SOURCES

The following data sources were accessed for this project: 1. Global environmental tracking system - a repository of all sustainability projects and historical energy consumption at a site level with monthly granularity 2. PI system - a database of sensor data from individual assets 3. Past energy assessments 4. Qualitative data from site visits and stakeholder interviews 5. Vendor quotations

Data Types and Format

Data was available in a variety of formats, including, but not limited to: a) Excel files, b) .csv files, c) PI graphs d) written reports, and e) stakeholder interview notes.



Author: Daniel Willette

IMPACT

This project aimed to assess and quantify Scope 1 emission reduction opportunities in line with Amgen's three-pronged strategy focused on innovation, efficiency, and renewable energy. The project encompassed both established technologies and emerging solutions. Utilizing an optimization model, the study prioritized initiatives that maximize net present value (NPV) while ensuring carbon neutrality. This model charts sustainable routes to carbon neutrality, while minimizing the utilization of decarbonization efforts such as carbon removals or high-quality carbon offsets. Furthermore, the findings guide current prioritization of carbon abatement strategies and offer insights for future sustainability targets beyond 2027. The adaptable optimization model remains a valuable tool, amenable to updates with refined data and assumptions, facilitating the evolution of innovation, efficiency, and renewable energy strategies for building utilities.

DRIVERS	The biotechnology industry has unique challenges in reducing Scope 1 carbon emissions due to the clean manufacturing and lab processes they manage. To achieve carbon neutrality, Amgen has a three-pronged approach focused on innovation, efficiency, and renewable energy. This project set out to better understand how to permanently reduce Scope 1 emissions in building utilities in line with Amgen's strategy.
BARRIERS	Granular energy consumption data was often unavailable at a building or process level. Past site energy assessments and validated assumptions were required to fill these data gaps.
ENABLERS	Incredible support from the project supervisor, as well as supportive peers and LGO alum within the organization. The company has a collaborative culture focused on its mission, team support, transparency, innovation. The large organization is easy to navigate; this made it possible to access necessary tools, acquire data access authorization, organize travel, and coordinate meetings with stakeholders.
ACTIONS	Subject matter experts were key stakeholders in the project and their expertise enabled the creation of the model and its inputs. The model findings were presented to those subject matter experts and the Sustainability Engineering team for feedback, a review of the insights, and discussion. The outputs of the research and model will help to shape the future sustainability strategy.
INNOVATION	An innovative aspect of this solution is the use of a linear optimization model to select capital projects. In parallel, innovative and emerging emission-reducing technologies, which have not yet become standard practice in commercial building utilities or biotechnology processes, was researched and recommended for future investigation and pilot projects.
IMPROVEMENT	The outputs of this project provide updated projections of capital requirements and operating costs to implement solutions which reach carbon neutrality in line with Amgen's approach focused on innovation, efficiency, and renewable energy. Additionally, the research provides a view of applicable projects and their associated costs to help inform future budgets for sustainability programs.
BEST PRACTICES	Focus on accessing granular building and process energy data as quickly as possible. Where gaps are identified, create a path to close those data gaps, or even pursue long-lasting side projects such as the installation of key sensors and data collecting mechanisms.
OTHER APPLICATIONS	Once innovation, efficiency, and renewable energy projects, affecting either Scope 1 or 2 emissions, are identified and analyzed, the model can be applied to any organization aiming to identify carbon neutral implementation paths which maximize NPV, minimize annual OpEx, or minimize the marginal abatement cost.

Understanding and Reducing Virtual-Physical Mismatches and Missorts in Fulfillment Centers

Amazon

BUSINESS PROBLEM

Delivery Estimate Accuracy (DEA) is the Amazon Operations metric that measures the percentage of items that attempted delivery on or before the Promised Delivery Date. There are significant costs and customer experience impacts when packages are not delivered on time, resulting in a DEA miss. Virtual-Physical Mismatch (VPM) and Missort are two major types of DEA misses that are difficult to detect and prevent. This project focuses on understanding and reducing the number of VPM and Missort misses in Fulfillment Centers, with the scope being Amazon's Traditional Non-Sort Fulfillment Centers in the US.

APPROACH

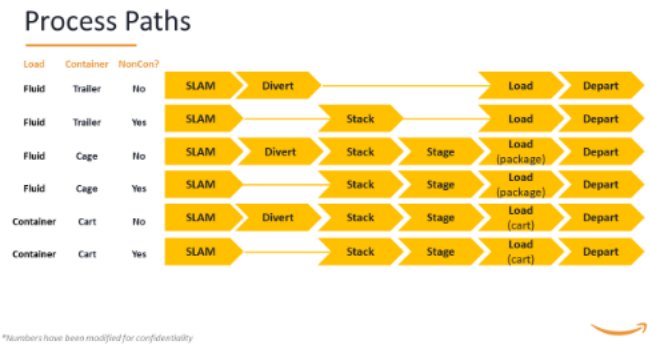
The project was conducted in 2 phases – understanding causes and exploring solutions. For causes, the current process and misses were analyzed and multiple linear regression models were built. Solutions were brainstormed with domain experts and condensed to 7 for pilots and studies. Expected costs, savings, efforts, impact, and effects on staff experience were quantified for prioritization.

DATA SOURCES

The majority of the data is based on system logs of shipment history, including package attributes, container types, timestamped scans, and planned routes. Additional data leveraged from business intelligence dashboards, such as quality defects and staffing. Some pilot data were collected via stopwatch and counting. Qualitative data were collected through 20+ stakeholder interviews.

Data Types and Format

Internal databases and clusters were accessed via Amazon's web browser-based SQL client. CSV and Excel files exported from business intelligence dashboards. Some pilot data were collected manually.



Author: Jenny Yao

IMPACT

N/A

DRIVERS

Coming soon

BARRIERS

Coming soon

ENABLERS

Coming soon

ACTIONS

Coming soon

INNOVATION

Coming soon

IMPROVEMENT

Coming soon

BEST PRACTICES

Coming soon

OTHER APPLICATIONS

Coming soon

R&D | Energy | Network optimization | Linear / Non-Linear

Co-optimizing transmission, renewables and storage for FPL's Real Zero goal

BUSINESS PROBLEM

FPL (Florida Power & Light Company) has a goal to be "Real Zero" by 2045, which requires the company to eliminate all Scope 1 and 2 emissions. To do that, FPL plans on relying largely on solar and energy storage. Florida's regulatory environment supports choosing the least expensive option, so it is critical that all Real Zero projects are cost-effective. The challenge I am working on is how to find the lowest possible cost option by co-optimizing the deployment of solar, storage and transmission. Disclosure: this work is a sensitivity analysis and does not represent concrete plans or analyses for FPL.

APPROACH

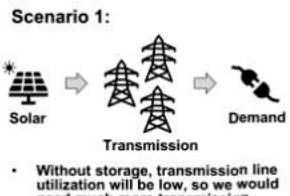
My key focus will be on evaluating the advantage of coupling on-site energy storage with solar and how that changes transmission and solar deployment. For example, with on-site storage, transmission becomes relatively less expensive (due to higher utilization) and flat, ground-mounted solar becomes more attractive (because the "peakier" production profile can be smoothed by the storage).

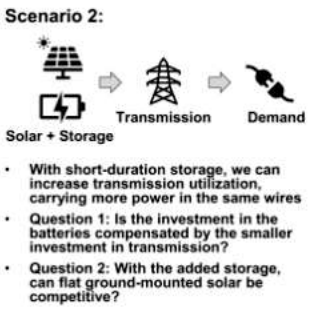
DATA SOURCES

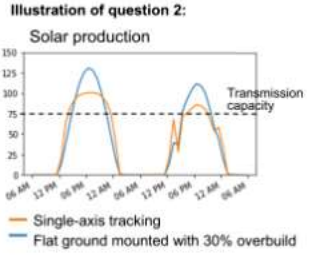
I will use three data sources: 1. Solar data - National Solar Radiation Database (NSRDB) historical irradiation data. 2. FPL electricity demand (FERC Form No. 714 has this open data). 3. Transmission, solar and storage costs from different sources. It is important to note that all data sources are publicly available and no internal data from FPL will be used in this work.

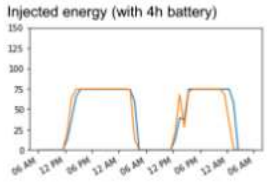
Data Types and Format

Time series of solar irradiation, electricity demand in FPL, and costs (for solar, storage and transmission).









Author: Marcelo Aguiar

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

Operations | Telecom | Network optimization | Linear / Non-Linear

Sustainability Analytics: Network Decommissioning Strategy & Optimization

verizon

BUSINESS PROBLEM

Verizon faces significant overcapacity in their central offices. Historically a standard, T1 copper lines now are challenged by technological shifts towards fiber and broadband. With customer migration, many T1s remain underutilized. (max 24 channels per circuit) Presently, manual methods identify "zero-fill" and "low-fill" devices, constituting >60% of central offices. Without strategic equipment consolidation, energy and cost-saving opportunities are lost. Amidst rising T1 costs, there's a pressing need to strategically decommission outdated T1s, addressing underutilization and conserving energy loads.

APPROACH

Start with data from a single central office's Excel file as a pilot. Using Jupyter, process and analyze this data. With insights from the pilot, develop initial, scalable Python scripts for multiple central offices. Engage with Network teams to identify and enhance optimization pathways. The strategy will serve as a blueprint, highlighting gaps, required data, and steps for team continuity.

DATA SOURCES

Using Excel files provided by the decommissioning team for each central office. Aim: Obtain direct read-only database access that feeds the iEN Legacy DCOMS dashboard, bypassing manual Excel extraction. The dashboard pulls data from the NAR (Network Analytics and Reporting) database.

Data Types and Format

Relational Databases. Excel.

1. **Data Acquisition**
   - Excel Data Files
   - Central Office Data
2. **Initial Data Exploration & Cleaning**
   - Jupyter Notebook
   - Basic Stats / Clean Data
   - SME Input
3. **Initial Modeling**
   - Preliminary Model With Initial Constraints
4. **Optimization Framework**
   - Enhance Data
   - Validate w/ SME
5. **Data Analysis and Recommendations**
   - Analyze Impact Opportunity
6. **Feedback & Iteration**
   - Validate Model w/ Historic Data
   - Iterate On Model
7. **Final Report & Strategy**
   - Potential for Scaling
   - Next Steps

Author: Shiv Bhakta

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

Improving Supply Chain Resiliency through Solar Panel Delivery Optimization

BUSINESS PROBLEM

Given the disruptions to the global solar supply chain and NextEra Energy's accelerated growth, the company's solar panel allocation process is gaining complexity. The allocation process results in a schedule that dictates the delivery of 150 million panels to the 50+ projects which are under construction simultaneously, while balancing requirements from multiple stakeholders. Due to project and contract interdependencies, modifying the delivery schedule leads to costs with consequential impacts across projects. An automated approach to allocation is necessary to minimize costs and make prompt strategic decisions across a growing portfolio.

APPROACH

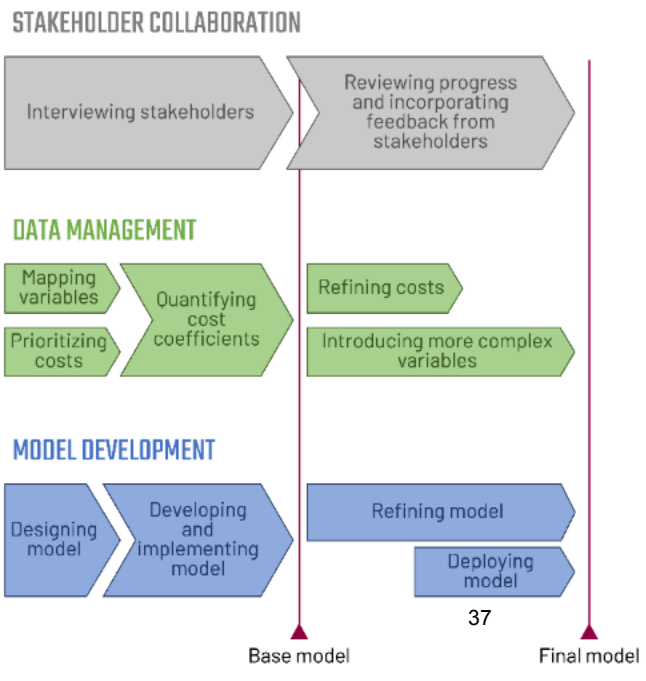
Since an ideal delivery schedule minimizes portfolio costs while meeting various stakeholder constraints, the project will automate solar panel delivery scheduling with an optimization. First, it will create a "sandbox" model to develop insights into the decisions that the model would have made in historical disruptions. Then, it will refine the model to generate pragmatic, strategic solutions.

DATA SOURCES

Data sources are mostly internal and are comprised of current and historical delivery schedules, contracted volumes per supplier, production schedules per supplier, cost data points, and revenue data points. These data come from the Pricing & Analytics project sponsor team, as well as the Commercial (Development), Contracting (Supply Chain & Early Stage), Construction, and Logistics stakeholders.

Data Types and Format

Structured data include Excel spreadsheets. Unstructured data include contracts and documents in PDF formats and interview notes, which were used as inputs for the cost and revenue estimations.



Author: Regina Ceballos Mondragon

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

Low Volume High Mix Platform Roll-up

LFMcapital

BUSINESS PROBLEM

The Weller Metalworks platform is seeking to understand how to best integrate portfolio companies that have many different systems, operations, and processes. Integrating businesses that have been family owned and independently operated for years poses a variety of challenges, so this research aims to provide recommendations to address those challenges and to develop guidelines to facilitate the integration. Specifically, there have been two recent acquisitions for the Low Volume High Mix platform, and now, the Weller Metalworks platform must determine how to best proceed with both companies performing as one consolidated organization.

APPROACH

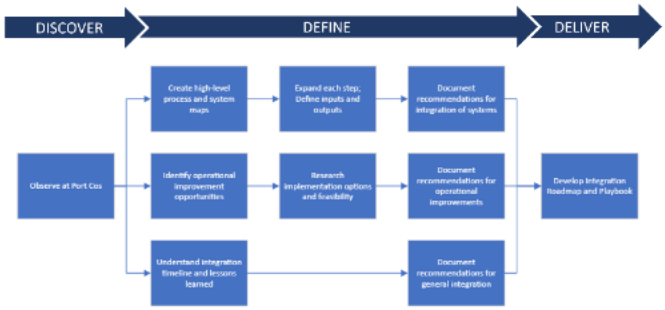
Integration, in general, is an extremely broad topic, so I focused on the production operating systems at each site. I plan to approach this problem by first observing the systems in use at both portfolio companies. From there, I will learn more about the inputs and outputs for each system. Then, I will provide recommendations based on my observations on how to best standardize the systems.

DATA SOURCES

The data for this research will primarily be system maps for the production operating systems at each site as well as high-level process maps. These will come from my observations and meetings with the subject matter experts at each business. There will also be data from the ERP on the annual sales revenue and unique SKU numbers that will be included in the background information for each company.

Data Types and Format

Process Maps, System Maps, Sales Data, SKU Data



Author: Priya Chacko

IMPACT

By developing an integration roadmap and playbook, this research will achieve three goals: first, it will document the lessons learned from each acquisition; second, it will set up the current portfolio companies for future success as they work together as one consolidate business in the Weller Metalworks platform; and third, it will serve as a guide for future acquisitions and improve the integration process of those portfolio companies.

DRIVERS	TBD
BARRIERS	TBD
ENABLERS	TBD
ACTIONS	TBD
INNOVATION	TBD
IMPROVEMENT	TBD
BEST PRACTICES	TBD
OTHER APPLICATIONS	TBD

Assessing Technical Health of R&D Software Assets Using Incident Ticketing Data

Multi-National Pharmaceutical Company

BUSINESS PROBLEM

Information about the technical health of a software asset is not understood comprehensively. Given the 600+ software assets within Digital R&D, a significant data volume about the assets is collected. For example, over 15,000 incident tickets a year are generated from users, but technical concerns are investigated as a siloed incident and only when the user experiences and reports the issue. The business remains reactive to issues affecting software, and existing data could be leveraged to empower the business with the insights and tools to resolving recurring problems.

APPROACH

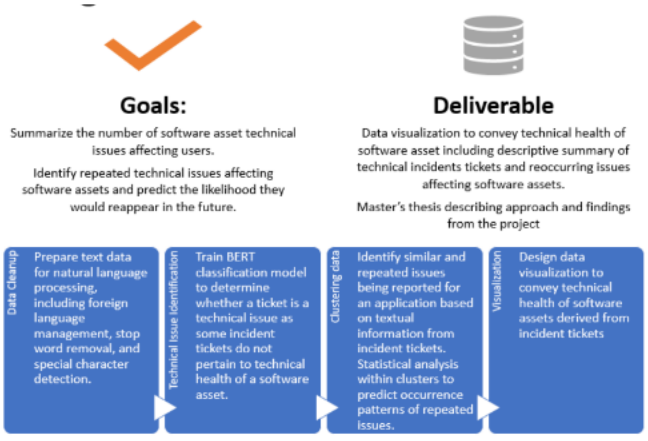
The Incident Tickets System manages application issues and requests-for-help reported by users and contains data that reveals the technical performance and stability of an application. Using natural language processing to infer meaning in incident tickets and clustering methods to identify similar application issues, insights on the technical health of a software asset can be obtained.

DATA SOURCES

Incident data from Incident Ticketing System manages issues with software applications reported by users. General information about software assets is available through the business' software asset management system. The cybersecurity team maintains a database tracking obsolescence associated with software assets.

Data Types and Format

Unstructured data (text from resolution notes and description of issue encountered) from incident tickets. Incident tickets also contain structured information.



Author: Jackie Chen

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

Product design / development / engineering | Metals and mining | Product design and testing | Constrained / Unconstrained

Pilot Proof-of-Value Site and Nuclear Reactor Partner Company Selection

BUSINESS PROBLEM

Caterpillar aims to provide sustainable microgrid solutions to mining customers to help reduce their carbon footprint. Nuclear Microreactors have emerged as a possible addition to their microgrid solutions however due to the novel nature of these systems, Caterpillar needs a quantifiable approach to determining their suitability for a site and a suitable partner to work with. A set of frameworks would be required to: 1) Identify suitability of mine sites to use microreactors 2) Identify Pilot site 3)Identify suitable partner through financial analysis, timelines & possibility for ROI in feasible timeline

APPROACH

1) Interview mining companies and read public reports. 2) Develop questionnaire from information obtained. 3) Interview reactor companies to understand timeline, investment requirements and estimated costs. 4) Develop database of parameters of companies. 5) Integrated database and questionnaire to help provide numerical score of site suirability and suitable reactor company.

DATA SOURCES

Public reports by mining companies; Public announcements by nuclear microreactor companies; Interviews/calls with mining companies and nuclear reactor companies

Data Types and Format

Audio; Reports

Author: Matthew Chew

IMPACT

Quantifiable score that can help Caterpillar identify suitable Pilot sites and possible beachhead market. In addition, this could help quickly identify what gaps in infrastructure that needs to be built if needed. Shortens lead time for analysis and provides a quantified approach for justification and analysis.

DRIVERS

Caterpillar mining customers are on a path to reduce their carbon footprint through the electrification of the machines on the site. This effort to electrify the mines is creating a large demand for clean energy at the mines. Caterpillar's mining customers are looking to Caterpillar to assist with identifying optimal solutions.

BARRIERS

Lack of knowledge: Many unknown unknowns with a technology that does not have any prototypes in the market

ENABLERS

Top management support: Desire by internal pillars to provide solutions to reduce carbon footprints; Caterpillar's unique position as both machine and energy production (EP) in various sectors

ACTIONS

Product research; mine site visits; software simulations

INNOVATION

Development of a framework that replies on a series of questionnaires and databases which some elements of system dynamics to provide a quantified numerical score.

IMPROVEMENT

A quantified approach to score and determine microreactor suitability for a mine site and a score to identify suitable microreactor partners; Removes some uncertainty in determining a decision

BEST PRACTICES

Having clear knowledge of the critical numbers; Openness and transparency of needs/financials

OTHER APPLICATIONS

Heat process replacement: Maritime power generation; Database baseload/backup power generation

Oil & Gas Go-to-Market Strategy

BUSINESS PROBLEM

The Oil & Gas (O&G) industry is a high emissions emitting segment that the NextEra Energy (NEE) Origination team is targeting. A path for O&G companies to reduce their emissions is through electrification. This creates a growing opportunity for NEE to offer renewable energy solutions. This project is being used to understand megawatt (MW) opportunity by O&G basin. With this MW market sizing, the next steps are to understand what companies are operating in a basin and what specific products NEE can provide them to meet their electrification goals. A successful project will be developing a targeted strategy for NEE to approach O&G customers.

APPROACH

In developing an O&G strategy, 4 steps have been determined. My initial work focused on understanding current decarbonization strategies for O&G. Once the needs of the market are understood, the next step is to evaluate opportunity size, focused on basin geography. This market size will then be broken down into target accounts and target offerings. Lastly, I will focus on market execution.

DATA SOURCES

There are three buckets of data that will be utilized for this project. One is public information including companies 10-K's and sustainability reports. The second bucket is industry data; NEE subscribes to Enverus which is a platform with a variety of information on O&G operations. The third bucket is internal knowledge including salesforce information and O&G industry experience.

Data Types and Format

Public Reporting: Data Tables & Qualitative Information, Enverus: Data Tables and Mapping, Salesforce & Internal Information: Qualitative Information

Author: Rebecca Cohen

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

Operations | Metals and mining | Improved process performance | Regression analysis

A Data Driven Approach to Reduce Energy Consumption in Aluminum Rolling Mills

AMERICAN INDUSTRIAL PARTNERS

BUSINESS PROBLEM

Due to increased energy prices in Europe because of the war in Ukraine, Aluminium Duffel (AD), a leading manufacturer of rolled aluminum, has experienced increased operating costs that greatly affect its profitability. As such, AD aims to implement energy reduction initiatives that can help tangibly reduce energy costs. The objective of this project is to execute and open-ended, data-driven search for energy savings opportunities across the plant and develop tangible implementation plans for the found initiatives.

APPROACH

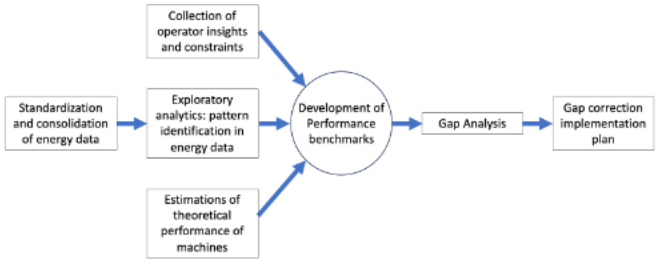
My approach involves first consolidating all available energy data into a usable format and from there, start an open-ended analysis of energy consumption within the plant. This involves finding patterns across the data that are not visible by looking at the operations. Vital to this approach is establishing a usable baseline of optimal energy consumption to which to compare current consumption.

DATA SOURCES

Time-stamped energy consumption data per product is available for all machines and is scattered in different databases. Additionally, data from sensors within each machine is available from a centralized digital dashboard, which shows temperature, pressure, amperage readings, among others.

Data Types and Format

Data types include time series, tabular, and discussions with experts. Data is found within excel files and SQL calls from several databases.



Author: Juan Correa Nunez

IMPACT

The overall project effort to reduce energy consumption will enable AD to improve its profitability while also reducing its environmental emissions. Numerically, this project will allow AD to reach savings of around 2 million Euros per year out of the target 8 million per year that the plant needs to achieve by 2027.

DRIVERS

The dramatic increase in energy prices in Europe due to the war in Ukraine led to AD's profitability to be seriously impacted due to the increase in operating costs. As such, there is a direct need to reduce energy consumption while maintaining production levels in order to bring AD back to profitability.

BARRIERS

The biggest barrier was the lack of direction from within AD as to where energy saving opportunities existed. To date, AD has found energy savings opportunities by intuition of where energy is consumed. This meant that I had to develop a data driven approach to find energy saving initiatives. Another challenge was that energy data was scattered across multiple servers.

ENABLERS

Strong support from AIP and the AD teams. Both teams agreed equally that energy reduction initiatives were imperative and were open to exploring new ways of achieving this. This project carried high visibility within the company, making it obtaining support for it fairly straight forward.

ACTIONS

I consolidated all energy data in usable excel documents that allowed easy manipulation and analysis. From there, I started an open-ended analysis of energy consumption in order to find patterns or insights within the data. I then compared my findings to expected baseline energy consumption that I obtained or calculated from conversations with specialists or product recipes. This allowed me to identify performance gaps in the current operation.

INNOVATION

AD has relied on intuition to identify energy saving initiatives. My solution involves and innovative use of energy data to find energy saving opportunities that would normally remain hidden. Another innovative aspect of my solution is the integration of operator feedback and recipe times with the energy consumption data. This allows for data to be better analyzed and for proposals of initiatives that result in more tangible solutions.

IMPROVEMENT

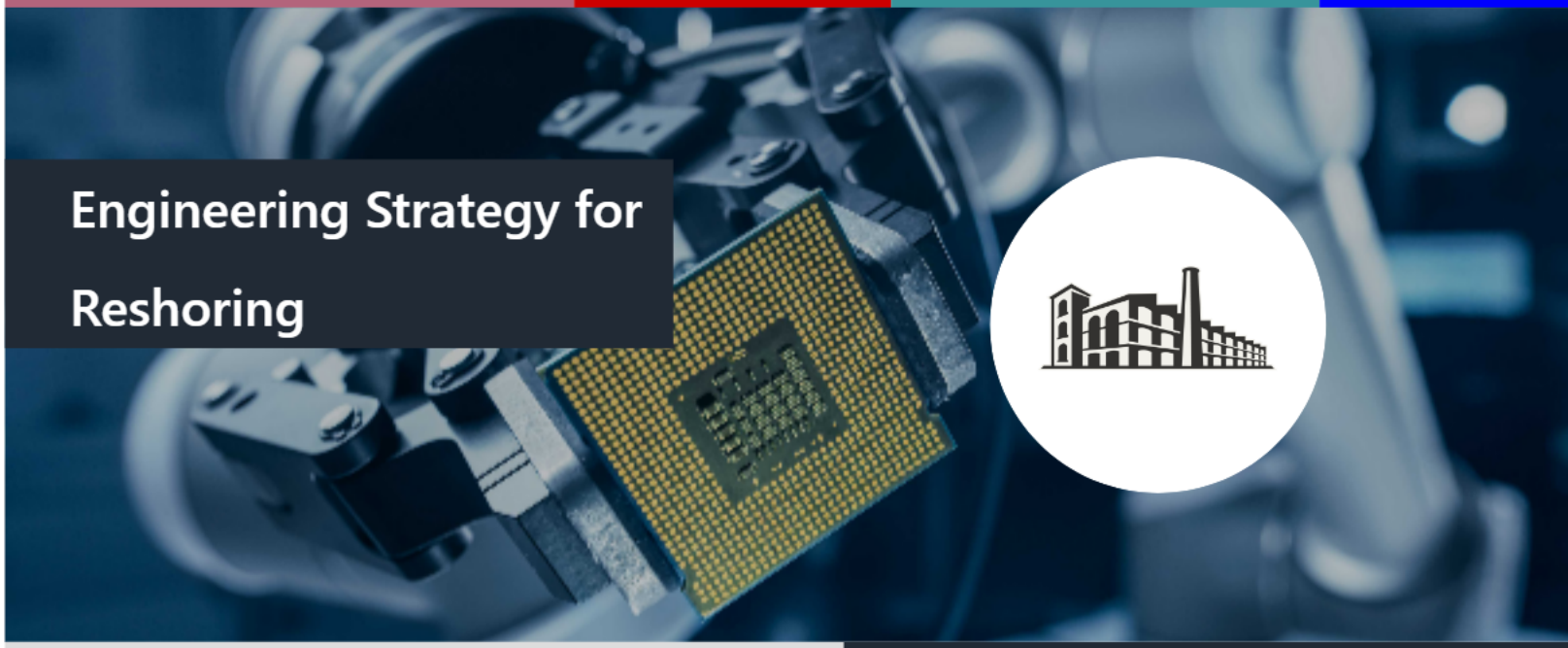
My solution will allow AD to save 1.5 million Euros a year in energy costs. This is significant, considering the companies goal to save 8.1 million Euros a year by 2027.

BEST PRACTICES

1. Incorporate qualitative operator knowledge into data analysis process to better understand results and findings. 2. Develop a thorough understanding of the technical/mechanical workings of each machines/process. This is critical to understanding where energy savings opportunities lie. 3. Be open to listen and develop relationships within the operations/manufacturing team.

OTHER APPLICATIONS

This approach can also be used to find operational inefficiencies. Similar to energy inefficiencies, operational inefficiencies can be detected by open-ended data analysis data is informed by operational best practices and theoretical production baselines. This approach can also be applied to other processes that use similar equipments, like steel rolling mills.



Engineering Strategy for Reshoring

BUSINESS PROBLEM

Re:Build seeks to find industries and value chains where it can leverage its capabilities and investments to successfully and profitably build manufacturing related businesses. Therefore, the project is to search very widely for opportunities, and assess those that look promising for addressing ReBuild's business problem by considering market intelligence, current programmatic pursuits, and existing portfolio strengths and capabilities. The project will thereby provide an independent, data-driven assessment of reshoring opportunities and Re:Build's product portfolio strategy optimality.

APPROACH

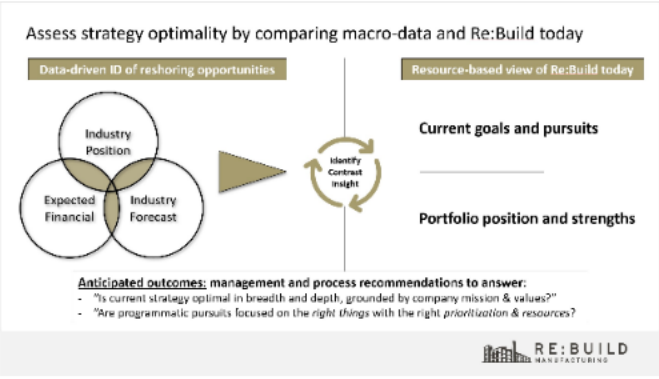
Conduct global trade and supply chain value assessment to identify and rank attractive product archetypes to reshore; validate business development efforts against company stated goals; map existing product portfolio to form resource-based view of capabilities. Compare and contrast aforementioned results to yield insights on optimal strategic positioning.

DATA SOURCES

- US trade data by HTS-10 product codes – US Trade Commission
- US Supply-Use Table by industry – Bureau of Economic Analysis
- OECD Input-Output Table by country and industry – OECD -
Industry sector profitability data – Multi-source, aggregated -
Industry sector growth projections - Multi-source, aggregated -
Reshoring price comparison survey – Reshoring Initiative

Data Types and Format

MS Excel and CSV



Author: Jack Easley

IMPACT

Re:Build has many opportunities knocking on its doors as the young company enters growth stage with a portfolio of capabilities. Against such backdrop is a fundamental strategic question of how it may best achieve its aspirational growth, balancing focus between capitalizing on existing products and endeavoring on new pursuits. Under such context, this project serves to provide an independent assessment of reshoring opportunities and uncover management/process recommendations to answer 1) "Is the company's current strategy optimal in breadth and depth, grounded by stated values?" And 2) "are the right things being pursued with the right prioritization & resources? A successful outcome will inform and help shape the company's growth strategy to achieve its long term mission.

DRIVERS	With both resiliency of extended global supply chain tested by COVID and the increase in geopolitical risk such as armed-conflicts in Europe, the idea of reshoring manufacturing capabilities has gained momentum both in popular press and in studied business decisions. There is interest to look broadly at what the prime candidates for reshoring are, and such analysis would be more useful when viewed under established strategy frameworks.
BARRIERS	The biggest barrier to the project are data availability and detail sufficiency. Specifically, global supply chain data availability, cross-source concordance, and levels of detail proved challenging to find and merge for insight.
ENABLERS	The project benefitted from direct support of supervisor and project sponsor as well as overall company culture of collaboration and openness to experiment.
ACTIONS	The key framework that enables project success is the Deming cycle of iterative development. As the project naturally evolves to maturity, it is important to set the overall framework but allow for room to absorb additional information to support a systems level solution on the strategy question.
INNOVATION	Macro-data analysis and join of information across sources to form a reshoring opportunity ranking model that outputs results at a Harmonized System (HS) – 4 code level of detail goes a step beyond traditional studies of reshoring which typically stays at a generalized characteristic point of view.
IMPROVEMENT	A model to enable broad scan of reshoring opportunities at the Harmonized System (HS) product level to allow for visibility and prioritization when making strategic investment decisions in labor, assets, or capital. A higher level output will also be frameworks to inform business development execution with regards to programmatic pursuits.
BEST PRACTICES	Ensure model interpretability and data source traceability.
OTHER APPLICATIONS	To be determined once model and output is finalized. Immediate adjacency applications may include research in support of international trade and industrial investment decision support.

Product design / development / engineering | Healthcare / Pharmaceuticals | Product design and testing | Rules-based

Coronary Artery Disease Patient Identification from Medical Records

Johnson&Johnson

BUSINESS PROBLEM

Abiomed's Impella pump is indicated for use in high-risk percutaneous coronary interventions (high-risk PCI or HRPCI) to support heart function during the procedure. The company is sponsoring the PROTECT IV trial to create evidence toward a clinical guideline with Class I recommendation. High-risk PCI itself is an emerging, life-saving clinical option for patients with complex coronary artery disease (CAD) that are often not offered revascularization or are lost to follow up. Abiomed is building a screener to support clinicians (specialized in complex PCI techniques) in identifying eligible patients within their health systems.

APPROACH

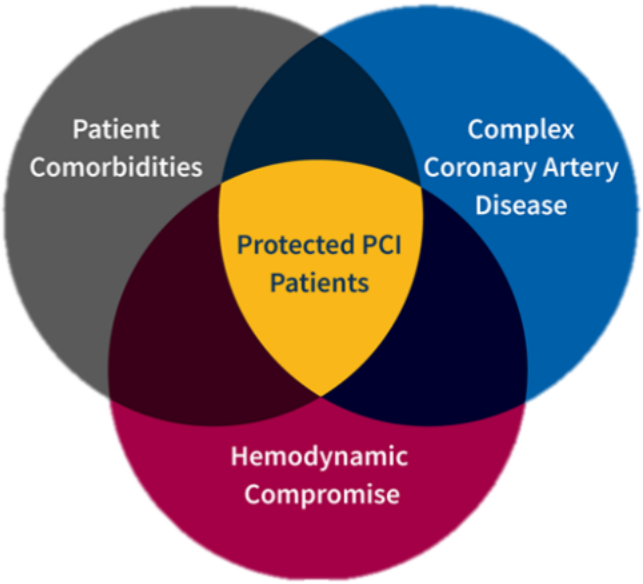
To support the Abiomed team working on this problem, I will focus on a specific component of the algorithm: presence and severity of obstructive coronary artery disease (OCAD). I'll advance the algorithm's ability to identify and characterize OCAD with NLP techniques learned from registry clinical reports. I will also support the broader problem with comprehensive population analyses.

DATA SOURCES

Patient data is complicated to access. I will use deidentified cardiac catheterization reports available to Abiomed in their cVAD registry. This data will support the narrow focus of testing text-parsing for the OCAD component. For tackling parts of the broader problem, I have access to clinical data aggregators (limited mostly to structured EMR data) and the tool is piloted at health systems.

Data Types and Format

Cath reports: ~300 PDFs (scanned document images) which I've converted to text via OCR. Clinical data: Patient records accessed via 3rd party data environment and standardized to OMOP.



Author: Leah Gaffney

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

TBD

Sustainability Assessment Framework for Additive Manufacturing

BUSINESS PROBLEM

Over the past decade and a half, Stryker has developed advanced capabilities in additive manufacturing in both metal and plastic materials. They have also begun planning to hit their carbon neutrality by the end of this decade. To facilitate reaching these goals, the additive team wants to be able to assess the environmental impact of their various technologies and the products created by them. The goal is to create an analytical framework using the data captured during the manufacturing process to derive a sustainability metric used alongside current cost metrics (NPV, IRR, etc.) to evaluate products holistically.

APPROACH

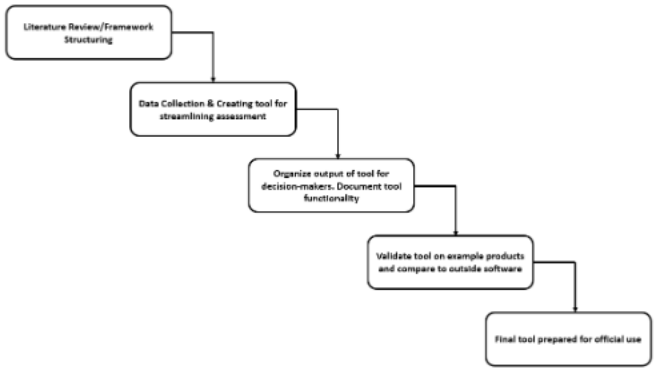
I will begin by concurrently reviewing literature on sustainability efforts in AM, current best practice and methods, while gathering available data from the operations and R&D teams at the Angrove site. The research along with advice from Stryker employees will inform the structure of the framework while the data will be the content.

DATA SOURCES

Much of the information on the process came from employee interviews and documentation. For the assessment, the data will come from equipment output or surveys conducted by the company, augmented by data from literature.

Data Types and Format

Numerical



Author: Abe Gerzeghier

IMPACT

The framework will give the team insight into the environmental impacts of products earlier (although less accurate) than the current life cycle assessments they produce. Any sustainability benefits they can show over conventional manufacturing will help differentiate their products from competitors.

DRIVERS	TBD
BARRIERS	TBD
ENABLERS	TBD
ACTIONS	TBD
INNOVATION	TBD
IMPROVEMENT	TBD
BEST PRACTICES	TBD
OTHER APPLICATIONS	TBD

Product design / development / engineering | Healthcare / Pharmaceuticals | Improved process performance | Dimensionality reduction

Preemptive variation reduction in biologic drug substance manufacturing

SANOFI

BUSINESSPROBLEM

Sanofi operates bioreactors using two independent probes to monitor key parameters (e.g., capacitance, pCO2, pO2, pH, temperature). Probe drift can occur, influenced by unclear environmental or process factors, which can lead to the reactor to drift outside optimum operating conditions. The project aims to help operations decide (1) when inaccuracies in probe data occur, (2) which is the faulty probe, and (3) what underlying environmental conditions or process history that cause the probes to drift.

APPROACH

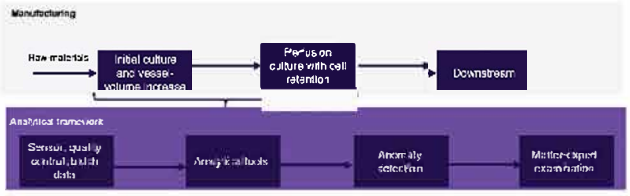
Multivariate statistical analysis and artificial intelligence algorithms will be employed for data analysis enabling targeted identification of probe inaccuracies and their contributing factors. The identification will be supported by modeling and engaging with process engineers and operators in a pilot plant and manufacturing operation.

DATASOURCES

Data will be collected from the semi-continuous bioreactor, including continuous sensor data, discrete quality control data, batch record data, and raw material data. This diverse range of data can be accessed by querying various systems within the company.

Data Types and Format

The data collected is in the form of timeseries. They comprise continuous (sensor) and discrete (sampling) data points. The data will be organized in a table format using spreadsheet software.



Author: Ismael Guereca Valdivia

IMPACT

The anticipated outcome of this project includes the development of a framework that flags drift in probe sensor data, decides on the identification of the inaccurate probe (from the two-probe instrumental set-up), and identifies variables that caused the drift in the sensor. Process engineers and manufacturing personnel can then use this information to (1) keep key operational parameters within optimal operating conditions and (2) identify underlying conditions or materials leading to probe drift, allowing for proactively making improvements to avoid sensor fouling. This will reduce the variability in the manufacturing process.

DRIVERS	TBD
BARRIERS	TBD
ENABLERS	TBD
ACTIONS	TBD
INNOVATION	TBD
IMPROVEMENT	TBD
BESTPRACTICES	TBD
OTHERAPPLICATIONS	TBD

Operations | Retail | Improved process performance | Supervised Learning

Planogram Optimization - Balancing the Trade-off Between Personalization and Standardization

BUSINESS PROBLEM

Target looks to solve the problem of optimal planogram (POG; the presentation of an assortment of items in-store) assignment. On a store-by-store basis POGs are ideally customized to the needs of guests of each individual store to maximize the local business. However, there is a labor cost associated with managing each planogram (designing, reviewing quality, implementing in stores), and thus a level of standardization is desirable. This work aims to identify the optimal point of customization, and the associated downstream financial impacts if implemented.

APPROACH

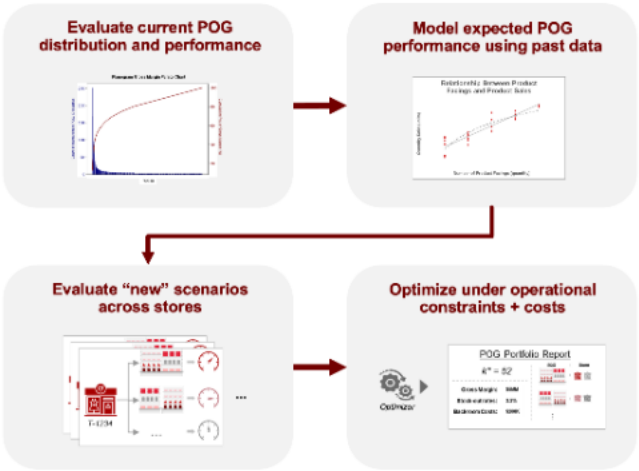
Using historical data, an item demand prediction estimates item performance in novel store scenarios, which enables POG performance estimation. A constrained knapsack optimization finds the optimal point of customization (required number of different planograms), balancing the trade-off between maximizing sales and the cost of managing planograms.

DATA SOURCES

Operational data is source from Target's internal database (BigRed 3), extracted via SQL queries. Additional visualization is done in Greenfield, an internally developed visualization platform. Additional external data sourced from their MapSpot geographical database.

Data Types and Format

Time-series and static data (e.g. daily operations, store attributes, respectively) consolidated to the relevant time-grain and extracted via SQL. Data types: binary, categorical, and continuous.



Author: Matt Habel

IMPACT

Placeholder

DRIVERS	Placeholder
BARRIERS	Placeholder
ENABLERS	Placeholder
ACTIONS	Placeholder
INNOVATION	Placeholder
IMPROVEMENT	Placeholder
BEST PRACTICES	Placeholder
OTHER APPLICATIONS	Placeholder

Optimizing Multiproduct Drug Substance Production for Increased Throughput

BUSINESS PROBLEM

The Sanofi Massachusetts Biocampus employs state of the art integrated continuous biomanufacturing (ICB) to produce multiple drug substances. This new technology allows for multiproduct production, but its flexibility introduces operational complexity not previously faced in the industry. Shared resources between products makes production capacity difficult to quantify. The Biocampus is struggling with a lack of understanding of their process capabilities leading to problems with resource scheduling, materials planning, and process variability, all of which have been detrimental to throughput.

APPROACH

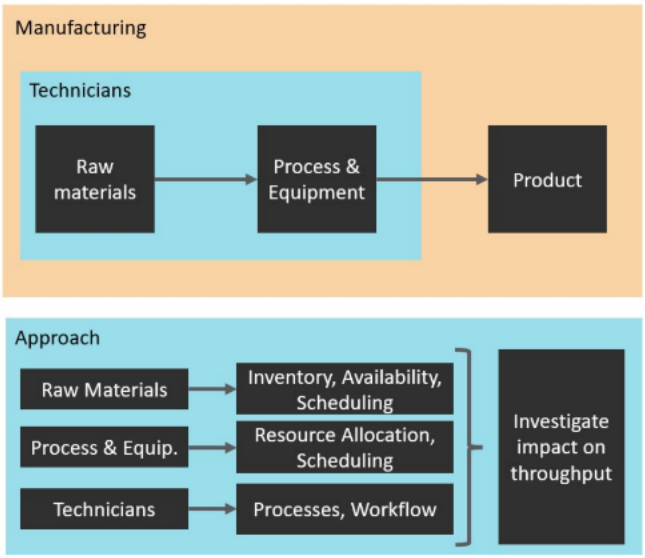
To increase throughput at current resource limits, linear optimization will be employed to improve resource scheduling and to increase capacity utilization. The model will also provide leaders with a framework to understand operations and resource needs. Lean principles will be applied to inventory balancing and storage techniques to increase material availability on the production floor.

DATA SOURCES

The primary data required is manufacturing data such as the resources and time needed to complete the process. The process must also be divided into a series of steps or operations. Some of this data can be obtained through Sanofi's manufacturing systems and process documentation. Other data, such as required technician labor hours per operations, is being collected via time studies.

Data Types and Format

The majority of data is collected and stored in excel spreadsheets. Some data is available for export from the site's SAP system.



Author: Ana Haddad

IMPACT

This project seeks to provide a deeper understanding of multiproduct drug substance production in an ICB facility. Current understanding of unit capacity considers each product's process individually, without regard for the shared resources which all processes utilize, labor, equipment, floor space, etc. The gap between theoretical single product capacity and true multiproduct capacity has led to scheduling and planning issues such as scheduling more daily operations than resources allow. To understand the site's true capacity, the operations will be modeled in two parts: upstream production and downstream production. These models will account for resource constraints to throughput so that better decisions can be made. In addition to the models, optimization algorithms will be developed as tools to aid in operations scheduling so that constrained resources are fully utilized. In addition to scheduling, unreliable material planning has negatively impacted capacity. The production area has limited space for inventory and shortages are common. Material shortage in the production area frequently causes hours of downtime. Material delivery to the suites operates as a push system. Critical materials will be mapped and used as case studies for pull system implementation. The expected impact is an increase in material availability in the production area. Together, the scheduling optimization and material planning efforts are expected to increase yearly production capacity.

DRIVERS

Test

BARRIERS

Test

ENABLERS

Test

ACTIONS

Test

INNOVATION

Test

IMPROVEMENT

Test

BEST PRACTICES

Test

OTHER APPLICATIONS

Test

Product design / development / engineering | Healthcare / Pharmaceuticals | Improved process performance | Linear / Non-Linear

Creating an Optimization Model for Hospital Inventory Management

Johnson&Johnson

BUSINESS PROBLEM

The AITA™ Smart System helps hospitals better manage their surgical inventory via three types of devices: Kiosks, Smart Shelves, and Mobile Hubs. Each device has its own planogram, which defines the set of products stocked in each device and the products' locations. Unfortunately, the current process to create these planograms is manual and time consuming (taking 2 to 4 weeks). The AITA™ team would like a tool that can automatically create and optimize planograms by determining which products should be placed in each device and the location of the products within the devices.

APPROACH

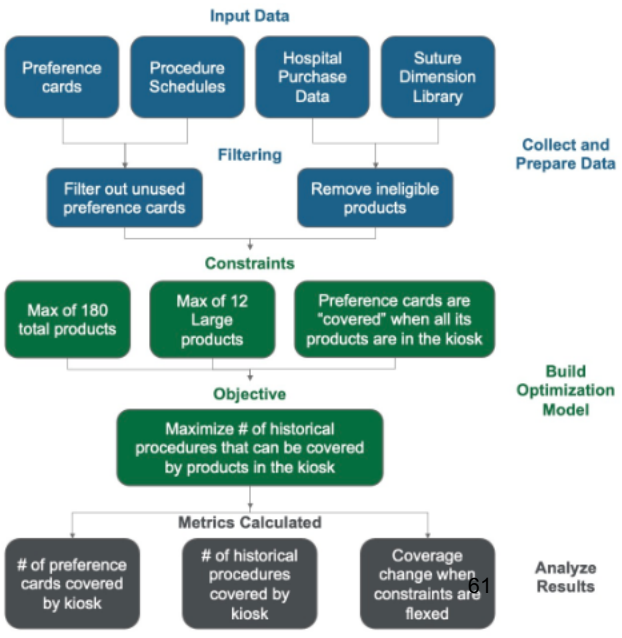
I will create models using Python and Gurobi to automatically design planograms. For the kiosks and hubs, I will write an optimization model to maximize the number of surgical procedures that can be covered by the devices. For the shelves, I will write a rule-based model that places products according to a set of constraints (e.g. by grouping similar products and sorting them by size).

DATA SOURCES

1) Preference Card Details: Summary of products surgeons need for each procedures. 2) Historical Procedure Schedules: List of procedures that took place at the hospital historically. 3) Historical Purchase Data: Products that were bought by the hospital over a specific period. 4) Suture Dimension Library: Sizes of each suture (can be small, medium, or large).

Data Types and Format

1) Preference Card Details: Structured, text. 2) Procedure Schedules: Text, time-series. 3) Purchase Data: Count, time-series. 4) Suture Dimension Library: Categorical, structured, static.



Author: Caeley Harihara

IMPACT

My solution will benefit the business by improving both the accuracy and efficiency of the planogram creation process. From an accuracy standpoint, my models will ideally produce better planograms than the ones that were previously created manually. Each devices has a different set of accuracy definitions. For kiosks, accuracy will mean being able to cover a higher number of total surgeries using kiosk products. For the hubs, it means having a higher coverage of add-on requests for procedures. Finally for the shelves, accuracy will necessitate meeting all the pre-defined rules for sorting products. For example, items must be grouped by item type and must be arranged based on characteristics such as size and needle shape. From an efficiency perspective, my solution should allow for a faster planogram creation process. Currently it takes roughly 2-4 weeks to go through the process of choosing products for the devices, deciding the products' order, and iterating with the clients on the final assortment and configuration. Ideally, with this model, the processes of creating the planograms and iterating through different designs will be faster. The model will eliminate the need for calculating coverage rates for individual items and for manually cross referencing the planograms against each design rule. It will also allow the team to quickly implement one-off inventory requests from the clients such as removing a particular product or making a substitution.

DRIVERS

The current process to create planograms for AITA™ inventory management devices has its challenges. The planograms are currently created manually, making the task time consuming, necessitating frequent iterations, and often leading to imperfect results. So, the team needs a model that can address these challenges by enabling fast, automated planogram creation, easily adjustable parameters, and optimized results.

BARRIERS

The largest barriers to the project have been implementation and integration into existing workflows. Now that the kiosk model is complete, it must be incorporated into the team's existing systems to ensure it is actually adopted. This will require linking the model to the central data repository, as well as reformatting the outputs so they can be directly fed into existing dashboards and visualization models.

ENABLERS

One of the best enablers for this project was my team's well-documented and well-organized data management system. My team keeps clear logs for every piece of relevant information including input datasets, business rules for inventory management, and logs of past planogram design attempts. These records, and my team's frequent support, ensured that I was able to access the data needed for my project, as well as understand how to use it.

ACTIONS

I made my solution more adaptable and easier to use, so that it could be more easily adopted by the data science team. On the adaptability side, I created dozens of mutable parameters that would allow the team to change factors such as the size of the device, the time period to consider, and the types of products to include. I also created a single Excel file that can control every parameter, so that the code itself does not need to be updated.

INNOVATION

My solution combines optimality with practicality. From an output quality perspective, it uses the software package Gurobi to generate optimized product selections. Then, from an ease of use perspective, my model automates many of the more tedious aspects of the planogram creation process. It cleans the input data files, pulls parameters from a central Excel, formats the output into an easy-to-digest visualization, and analyzes the results.

IMPROVEMENT

From an accuracy perspective, my model's planograms provide higher coverage than handmade solutions. For my team's largest account, the model's kiosk planogram covered 78.2% of all procedures (compared to the 73.1% coverage rate of the manually-made planogram). Furthermore, my model is more efficient than the current process. It takes a week to design a kiosk planogram by hand, while my model can be run in a couple of hours, start to finish.

BEST PRACTICES

I found it helpful to break the solution into smaller steps. For example, I have two separate kiosk models: one to choose the planogram's products, and one to place the products in the kiosk. An optimization model cannot perform both functions simultaneously, so they needed to be separated. From there, it is helpful to rigorously test the model with corner cases, and to validate the results with as many team members as possible.

OTHER APPLICATIONS

Within the medical space, the model can be used for general hospital inventory management by selecting products that are not even eligible for AITA™ devices. It can also be used on inventory problems in other industries. In the retail sector, it can stock products to maximize the coverage of customers' orders.

Operations | Agricultural products and processing | Inventory management / control | Discrete / Continuous

Product/SKU Analysis, Rationalization, and Optimization

LFMcapital

BUSINESS PROBLEM

IronCraft, an LFM portfolio company, is a high growth company that specializes in manufacturing skid steer and tractor attachments. The total number of stock keeping units (SKUs) has exponentially increased, to the order of millions of independent product offerings, which introduces variability into their manufacturing operations. This project is scoped to perform a SKU rationalization analysis and provide an optimized product offering list to support the overall growth of IronCraft. Beyond the SKU rationalization, there will be a focus on implementing Lean principles within operations for the company's top selling product families.

APPROACH

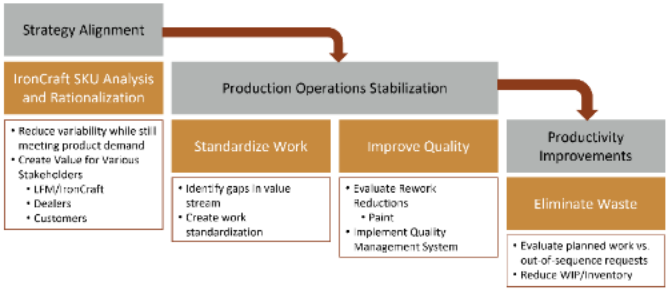
Strategy alignment is the first step to this problem by using a qualitative and quantitative approach to determine an optimized list of SKUs. Production operations can then be stabilized for those set SKUs by employing standard work and a quality management system to reduce lead times and rework. Finally, productivity improvements will be made by reducing waste and increasing profitability.

DATA SOURCES

IronCraft recently adopted a new ERP system, Epicor, to track parts and materials purchasing, orders and sales, production jobs, cost accounting, and shipping. This data can be queried and exported into excel files to be analyzed. IronCraft currently uses Power BI to evaluate large subsets of data which will also be used for this project to make decisions about its product offerings.

Data Types and Format

The data from Epicor is exported into excel spreadsheets and analyzed using Power BI data visualizations. For operational/production improvements, time series data and video were collected.



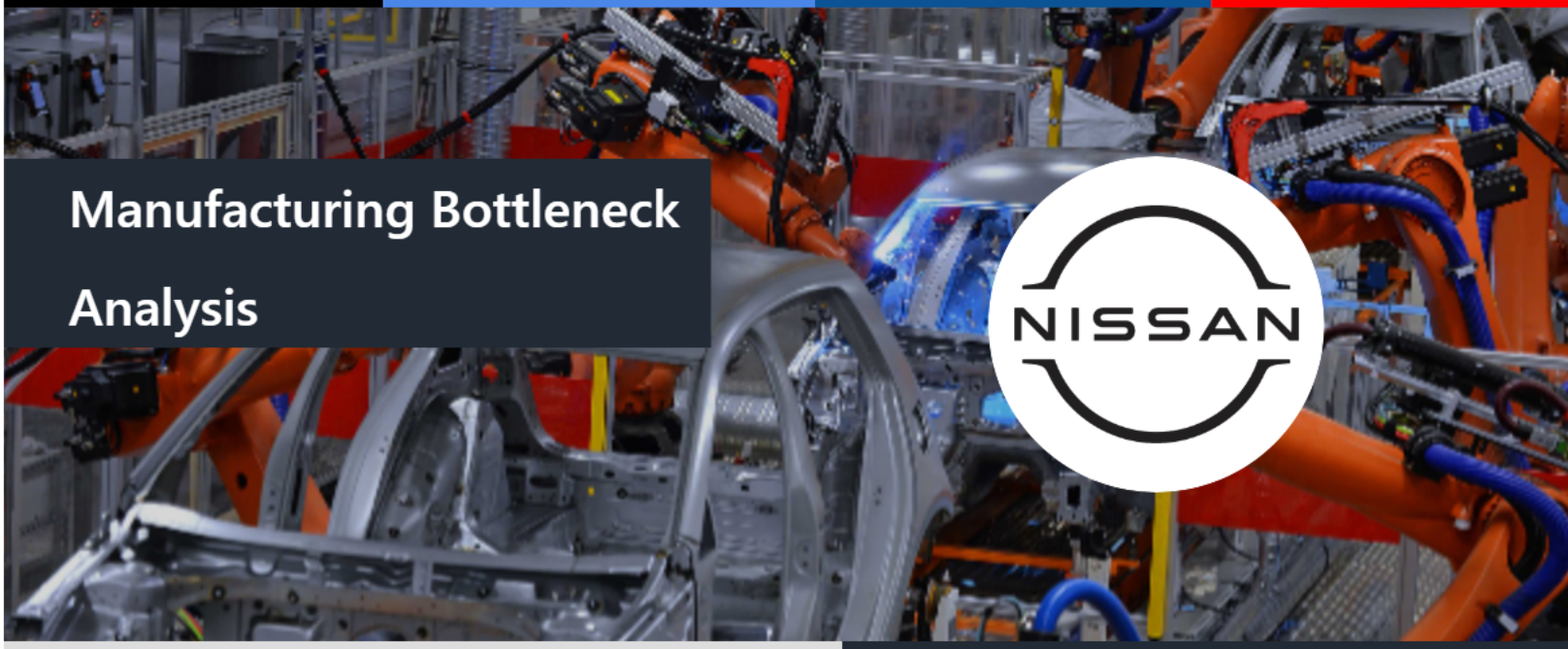
Author: Heidi Hatteberg

IMPACT

The tool created for SKU rationalization will help leaders make data-driven decisions to help leverage LFM's portfolio company synergies and drive value to IronCraft and LFM. The optimized product mix will help reduce inventory costs and overall footprint while also improving the overall value stream. Reduced SKU offerings will foster efforts in improving operational efficiencies and quality by driving standard work through high-moving products. Additionally, by optimizing IronCraft's product mix, the dealership network and end users will be better served by having the right product on site, ready to ship, and ready to use. This improves sales opportunities and helps the customers complete their tasks on time.

DRIVERS	Implements are designed to accommodate farmers with different farm sizes, soil types, crops, season, etc. so there are many types and variations of equipment created to fit each individual farmer's needs. However, this creates a high product mix that adds variability and complexity to its operations. Performing a SKU rationalization will help improve the overall value stream of of IronCraft's current manufacturing operations.
BARRIERS	While there was significant data to support the argument for a SKU analysis, there is also a qualitative piece to the analysis to ensure IronCraft's value to the industry. Customers, dealers, and sales representatives may have strong opinions towards specific SKUs over others that are rarely unanimous. Aligning everyone with IronCraft's vision to reduce SKUs to improve the overall growth of the company is the main barrier of this project.
ENABLERS	IronCraft/LFM and its leadership has been very supportive of this project as they see and understand the need for reducing variations and customizations to add value back into the company.
ACTIONS	After collecting the data to develop an initial design of the tool, I created use cases to begin the conversations around product mix and SKU rationalization. To complement this quantitative approach, I hosted several workshops with key leaders and decision makers (operations, manufacturing general managers, marketing, engineering) to add anecdotal information to develop a finalized list of product offerings.
INNOVATION	Considering that IronCraft has not had this level of visibility to their data, making this tool dynamic so that decision makers can interact directly with the data and make strategic decisions is very innovative for them. The decisions made using this tool also impact their overall value stream and streamlines their operations potential to be more lean and efficient.
IMPROVEMENT	Using this tool, we will be able to reduce IronCraft's inventory costs and overall footprint for both parts and finished goods (currently about 4.5 acres of inventory storage). Furthermore, by removing the variability across SKUs and focusing on the standard offerings, IronCraft will be able to improve their productivity and quality through 5S/Lean activities.
BEST PRACTICES	To better implement and replicate this solution, it would be a best practice for the ERP system to have a product hierarchy and standard nomenclature for SKUs offered. It is very difficult to automate aspects of this tool and analyze the data from different groups/angles due to data fields missing or not used the same across the various companies and product families.
OTHER APPLICATIONS	This SKU analysis tool could be used in various types of retail industries that offer a larger product mix to consumers. It could also be used to track orders and analyze consumer habits to improve forecasting for the seller/manufacturer.

Industrial Engineering | Automobile manufacturing | Cycle time optimization | Discrete / Continuous



Manufacturing Bottleneck Analysis

BUSINESS PROBLEM

A primary leadership objective at the Nissan Smyrna Plant is to obtain new business for the plant (i.e., plans to build vehicles at the plant), which requires strong performance and continuous improvement in key metrics such as man hours per unit and cost per unit. This project aims to drive continuous improvement in these metrics through two primary objectives: 1. To develop a formal understanding of production efficiency at the plant as driven by relationships between vehicle production work content, man hours per unit, and labor cost per unit; and 2. To leverage the model developed in (1) as a means of identifying production bottlenecks.

APPROACH

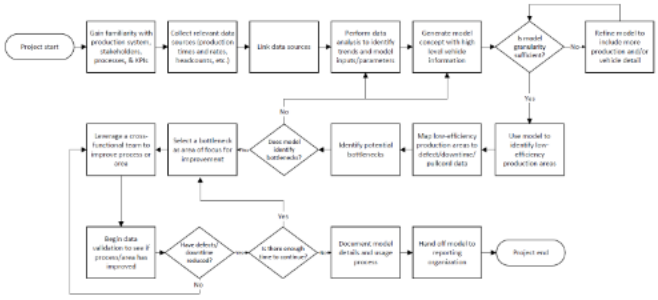
The approach thus far has involved learning the vehicle production process at the Smyrna plant, identifying KPIs for the plant, and understanding production parameters that influence those KPIs. The approach going forward will be to link data sources, investigate data trends, leverage trends to model production efficiency, and utilize the developed model to identify production bottlenecks.

DATA SOURCES

Product information guides containing vehicle trim package structures and option content; standard manufacturing times for vehicles produced at the Smyrna plant; historical headcount allocations by production area; historical planned and actual production rates; historical defect, downtime, and pullcord data

Data Types and Format

Nissan Rebalancing System (NRS), Microsoft Excel



Author: Cameron Hoffman

IMPACT

To be added at a later date.

DRIVERS	To be added at a later date.
BARRIERS	To be added at a later date.
ENABLERS	To be added at a later date.
ACTIONS	To be added at a later date.
INNOVATION	To be added at a later date.
IMPROVEMENT	To be added at a later date.
BEST PRACTICES	To be added at a later date.
OTHER APPLICATIONS	To be added at a later date.

Product design / development / engineering | Transportation and logistics | Product design and testing | Natural language processing

Amazon Delivery Service Partner Digital Focus Group Product

Amazon

BUSINESS PROBLEM

Amazon has an increasing need to improve the overall partnership experience with its internal customers, the Delivery Service Partners. Despite employing diverse listening mechanisms, the company struggles to derive actionable feedback for program leaders. The existing approaches fail to effectively translate gathered data into tangible insights, hindering decision-making and inhibiting the company's ability to respond promptly to its internal customer needs and preferences. Resolving this issue is critical to enhancing program effectiveness, improving customer satisfaction, and maintaining a competitive edge in the market.

APPROACH

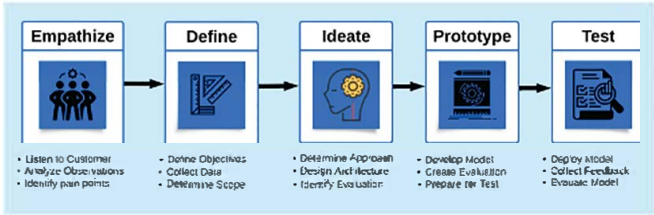
This problem will be approached using Design Thinking methodology, where collaboration with stakeholders, customer empathy, ideation, and prototyping will be performed alongside the application of Natural Language Processing tools. Through iterative testing, insights will be refined, empowering program leaders with actionable customer feedback to enhance overall satisfaction.

DATA SOURCES

Amazon: Customer interviews/feedback, social media, survey comments, monthly CSAT score

Data Types and Format

Unstructured text (Text/JSON): survey responses and feedback
Numerical data (Excel/CSV): ratings, scores, CSAT trends
Categorical data (Excel/CSV): multiple-choice responses, demographic information



Author: Steven Hubbard

IMPACT

By leveraging diverse data from surveys and pretrained NLP models, the solution enables improved survey interpretation which drive actionable insight generation. This will empower Amazon to make informed strategic decisions to align program requirements with internal customer needs, resulting in heightened customer satisfaction and improved program effectiveness.

DRIVERS	The catalyst was Amazon's recognition of a persistent challenge in translating gathered data into actionable feedback with the presence of an evolving artificial intelligence landscape. Improved NLP tools, advanced sentiment analysis, and deep learning capabilities sparked innovation and actions towards the solution.
BARRIERS	Adapting NLP tools to Amazon's specific needs may pose technical hurdles in extracting insights from unstructured data. Some stakeholders within the organization may be accustomed to traditional feedback methods, resisting change with artificial intelligence techniques. Lastly, designing a focus group product will require iteration and may not immediately yield tangible results, requiring patience from the stakeholders.
ENABLERS	Adapting NLP tools to Amazon's specific needs may pose technical hurdles in extracting insights from unstructured data. Some stakeholders within the organization may be accustomed to traditional feedback methods, resisting change with artificial intelligence techniques. Lastly, designing a focus group product will require iteration and may not immediately yield tangible results, requiring patience from the stakeholders.
ACTIONS	Solution has not yet been implemented but actions will include development of prototypes using available AWS tools and models, customer feedback data, and integration of existing data system. The solution will also include iterative testing and regular feedback from program leaders.
INNOVATION	Innovative aspects of the solution will be centered around the combination of human-centered design methodology with advanced language processing. The utilization of Natural Language Processing for sentiment analysis, topic modeling, and extracting actionable insights from unstructured text data will be a significant leap from traditional methods that required human analysis of large amounts of feedback.
IMPROVEMENT	To be determined, but the solution is intended to enable Amazon fleet program leaders to respond faster to internal customer needs resulting in improved customer satisfaction scores.
BEST PRACTICES	Regular feedback loops with stakeholders and end-users are essential to tailoring solutions intended to generate actionable feedback.
OTHER APPLICATIONS	An NLP-powered solution can be employed to analyze customer feedback across various channels, including surveys, social media, and focus groups. Sentiment analysis, topic modeling, and text summarization techniques can unveil nuanced customer sentiments and recurring themes which can then be tailored to generate strategic insights.

Operations | Healthcare / Pharmaceuticals | Inventory management / control | Deterministic / Stochastic

Predictive Modeling for Ethicon Endo Supply Chain

BUSINESS PROBLEM

J&J are committed to delivering life saving medical products to patients around the world. In order to deliver on this promise, J&J is investing in digital products to help ensure a reliable supply chain. Over the last few years, the industry has faced supply chain disruptions due to Covid, geopolitical tensions, climate events, regulatory change and more. These challenges are compounded by an increasingly interconnected, global supply network. This project will focus on the question: How do we predict and prevent a supply chain risk before it becomes a disruption?

APPROACH

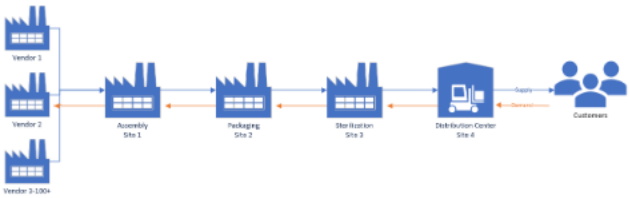
The project will follow the J&J DRIVE (Define, Retrieve, Innovate, Visualize, Effectivity) methodology for digital projects starting with process mapping of the supply chain to understand the current state of operations. Next, an analysis of historical data will inform an inventory optimization model. This will be used to simulate the effect of different events in the supply chain.

DATA SOURCES

J&J is rich with data, however the multitude of data storage and reporting systems can pose its own challenges. Some data is provided from contract manufacturers on a manual basis, other data is stored in raw format in a centralized data lake, and other data is already curated in the form of dashboards and reports.

Data Types and Format

The majority of data is stored in tables in Excel spreadsheets or accessible via a SQL database.



Author: Ian Kleinemolen

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

Operations | Aerospace and defense | Improved process performance | Auto-encoders

Using 3D Deep Learning to Deliver Quoting at Scale

LFMcapital

BUSINESS PROBLEM

J&E is interested in building a digital platform capable of shortening the manufacturing cycle on complex machined components from months to weeks. A key issue is their inability to accurately predict manufacturing methods and expected costing at scale. The current quoting process is all manual and heavily reliant on executive leaders with decades of experience in the industry to make these assessments based on tribal knowledge. To continue growing, this process must be digitized and integrate disparate data sources to generate these recommendations more efficiently. This will also enable better machine resource allocation planning.

APPROACH

Create and train a multi-stage deep neural network, that will ingest historic 3D part models, process through organized parallel layers, concatenate with other applicable data pulled from the enterprise resource planning (ERP), then provide separate regression and classification outputs. The trained model can then be used for the new quoted parts.

DATA SOURCES

The primary sources of data for the project came from machine part files and historic records in the recently implemented ERP. The researcher had to scrape much of the part and tool data from the company shared drive, while obtaining historic cost data through SQL pulls.

Data Types and Format

3D part data used was in the form of .stp, .step, .stl, .iges files, processed into point clouds and voxel grids. Historic costs were pulled from the ERP using SQL and stored in CSV files.

Author: Ryan Kochert

IMPACT

There are several common bottlenecks in the manufacturing process cycle between most job shops across the US. One of these commonalities is the ability to quickly triage requests for quotes (RFQ), identifying those that fit the capabilities of the company, as well as determining how long it may take to make that part. The impact of this tool will be determined after fully completed and integrated.

DRIVERS	The high precision CNC machining industry requires a tremendous amount of knowledge and expertise in the field to accurately predict the operations and costs of a future job. Many job shops hit an upper size limit not based on shortage of work, but rather capacity in key areas of the shop. One of those areas is quoting capacity and expertise, since that can typically only be learned through repetitions and time at the job shop.
BARRIERS	Working with spatial data in deep learning is difficult, as it exponentially increases the potential inputs the model could encounter. Typical deep learning models using convolution layers adopt basic data augmentation strategies to make the model more robust. The increased complexity of an additional dimension tends to decrease model performance drastically. As well, standard data formats for CAD files and ERP data cleanliness were challenges.
ENABLERS	TBD
ACTIONS	TBD
INNOVATION	TBD
IMPROVEMENT	TBD
BEST PRACTICES	TBD
OTHER APPLICATIONS	TBD

Supply chain planning and inventory management | Healthcare / Pharmaceuticals | Improved process performance | Rules-based

Enabling end-to-end temperature monitoring for cold chain pharmaceutical product

Johnson&Johnson

BUSINESS PROBLEM

Emerging pharmaceutical products at Janssen, such as gene therapies, require ultra-cold temperatures throughout the supply chain to maintain safety and efficacy of the product. The business is aiming to develop a monitoring approach and digital solution to improve decision-making to release a product to a customer based on its temperature exposure throughout the end-to-end supply chain. The project will focus on defining the requirements and solution for temperature monitoring for a new temperature-sensitive product, to mitigate risks of temperature exposure and improve management of excursions in the event that they do occur.

DATA SOURCES

Real time temperature data for select lanes, historical temperature excursion and product disposition report, and customer temperature inquiries data

Data Types and Format

Time series temperature sensor data, CSV extracts from Quality Management systems

APPROACH

I will first assess the current state systems and processes for managing temperature. Then, I will identify the drivers of temperature excursions and outline the necessary data and analytics to improve management. I will model the tradeoffs between cost and performance of the system. Finally, I will synthesize the findings and propose a solution for temp. monitoring for the new product.

1 Assess gaps in temp. monitoring

- Identify causes of **temp excursions**
- Analyze gaps in data, tech, processes

2 Define requirements

- Define **reference scenarios**
- Identify data, analytics to mitigate risk

3 Analyze constraints & tradeoffs

- Analyze cost of failure and **model tradeoffs** between cost & performance

4 Recommend solution design

- **Synthesize** requirements and plan

Author: Jessica Lee

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

A Strategic Roadmap for the Decarbonization of U.S. Freight Rail

BUSINESS PROBLEM

No viable options presently exist to address Scope 1 emissions (from sources owned by the company) for the freight rail transportation industry, particularly in locomotives. The primary drivers are gaps in battery technology and availability of near-zero emissions green fuels (i.e., hydrogen and renewable diesel). A roadmap is needed to decarbonize this industry from now to 5-10 years from now when technology catches up. NextEra Energy Resources would use this roadmap to engage with and transition their clients to lower-emissions energy sources.

APPROACH

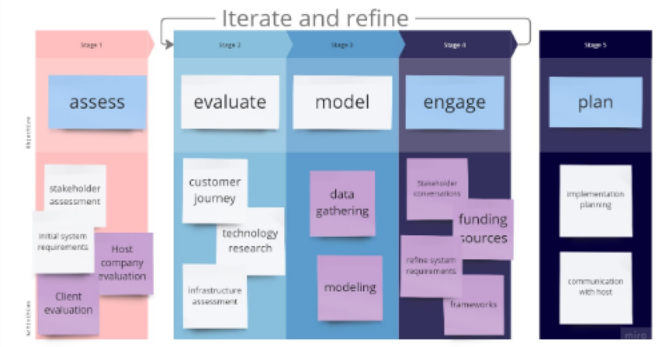
The approach to the project will be based on the principle of iteration and failing fast. Most stages of the project (outlined in 2b) will be done more than once to ensure that new knowledge and inputs are being properly reflected in the work and will propagate to the final deliverable. Below is the outline of different components of the projects.

DATA SOURCES

Given that the project is focused on a strategy, there will be a large amount of data collected through conversations with stakeholders. Stakeholders include subject matter experts within NextEra Energy Resources© and the freight rail industry. Additional data will be collected from public sources that document financial and statistical performance information on US freight rail.

Data Types and Format

Through stakeholder conversations data will be collected in the form of notes. Financial data is presented in Excel spreadsheets. Statistical performance data is presented in Excel spreadsheets.



Author: Ben Lerman

IMPACT

A robust understanding of the U.S. Freight Industry would allow for increased market intelligence for NextEra Energy's sales organization. Recently, NextEra Energy Resources has been increasing its energy solutions portfolio for commercial and industrial customers, including for U.S. freight rail companies. NextEra Energy Resources has discovered that the U.S. freight industry cannot be decarbonized using the traditional products that it has been selling. For this reason, it was decided that increased market intelligence of this industry would identify pathways for NextEra Energy Resources to play a part in the decarbonization of the U.S. freight rail system. This project would provide this knowledge to NextEra Energy Resources to be able to strategically engage with rail customers and realize their decarbonization goals. In total, sales to the U.S. freight industry could bring NextEra over $50 billion in revenue over the next 25 years.

DRIVERS

There are several key drivers that were identified that impact NextEra Energy Resources and its customers. First, NextEra Energy Resources' commercial and industrial sales teams is looking to continue to grow its offerings outside of wind and solar builds and power purchasing agreements. Second, freight rail companies are facing new regulations that are forcing them to reduce their emissions profile.

BARRIERS

The sales process prohibits me from speaking directly with freight rail companies. Further, the organization is so complex, it takes considerable time to find the right contacts. Finally, no precedent has been set for reducing Scope 1 emissions from current customer engagements.

ENABLERS

Support was provided by some members of the organization to leverage their external connections for stakeholder interviews. Additionally, the summer followed a structured schedule that concluded with a presentation given to the top executives in the company.

ACTIONS

I have created a financial analysis to understand the total cost of ownership and NPV of a rail company purchase of a new locomotive. The locomotives analyzed were switcher and line haul locomotives powered by either diesel, battery electric, or hydrogen fuel cell. I also summarized my findings in a final presentation given to my team and top-level executives. Further, I have initiated discussions with locomotive manufacturers in the U.S.

INNOVATION

One aspect is the estimation of rates at which different locomotive technologies are being adopted, as understood through technological readiness, net present value, and total cost of ownership. Additionally, part of the solution is to explore the creation of a joint venture between NextEra Energy Resources, a locomotive manufacturer, and a fueling infrastructure company.

IMPROVEMENT

The solution provides substantial market intelligence including financial analysis of locomotive technologies that ultimately creates a roadmap for NextEra Energy Resources executives. Once executed, this should provide additional revenue over the long term.

BEST PRACTICES

To continue having conversations with all stakeholders and updating the roadmap accordingly. The strategy is meant to be executed over the long term, so there will be new inputs that, when applied to the roadmap, can change its course.

OTHER APPLICATIONS

Governments and rail companies could use the information to have a better understanding of the pathway to decarbonizing freight rail.

Flexible Load Control for Green Hydrogen Plants - Selling Hydrogen Molecules vs Electrons

BUSINESS PROBLEM

In light of the recently passed Inflation Reduction Act (IRA), energy companies are looking to establish a presence in the green hydrogen sector. Although there is an increasing demand for green hydrogen, pre-IRA production costs surpassed those of conventional gray hydrogen, resulting in constrained market share for the green variant. The IRA incorporates production tax credits (PTCs) to mitigate the costs, expanding opportunities within the green hydrogen sector. Prompted by the incentive, energy companies are devising strategies to effectively compete in this quickly growing market.

APPROACH

A green hydrogen plant uses renewable power and conventional grid power to supply energy to electrolyzers to produce hydrogen. Excess generation is sold to the grid. Thus, there is always an opportunity cost to producing hydrogen: the cost of energy. By strategically throttling electrolyzer load in response to power prices, hydrogen producers may optimally monetize both hydrogen and energy.

DATA SOURCES

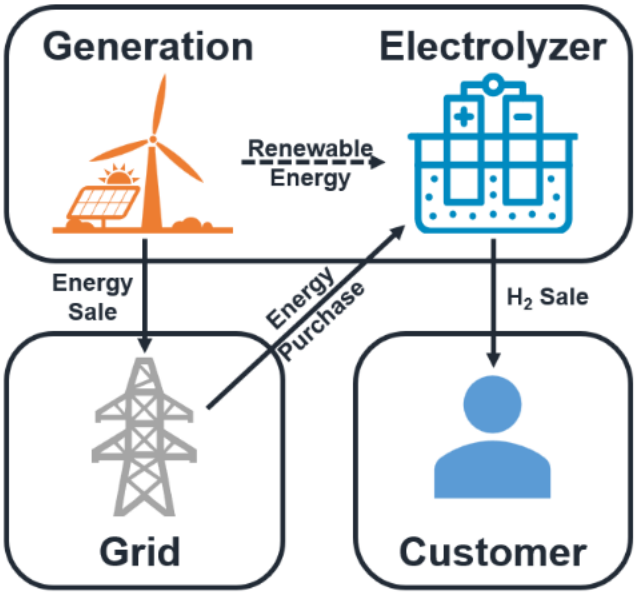
(1) Historical power prices from Yes Energy

(2) Historical wind and solar net capacity factors (NCFs) from a private database (similar datasets from National Renewable Energy Laboratory)

(3) Simulated/forecasted power prices with wind and solar NCFs from a private database (similar datasets from Wood Mackenzie and Ventyx)

Data Types and Format

Time series, 1hr granularity



Author: Brandon Meehan

IMPACT

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DRIVERS

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BARRIERS

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ENABLERS

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ACTIONS

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INNOVATION

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IMPROVEMENT

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BEST PRACTICES

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OTHER APPLICATIONS

Product Marketing | Aerospace and defense | Predictive forecasting | Graph-based neural networks

Sustainable Aviation Fuel Travel Demand Elasticity Study

BUSINESS PROBLEM

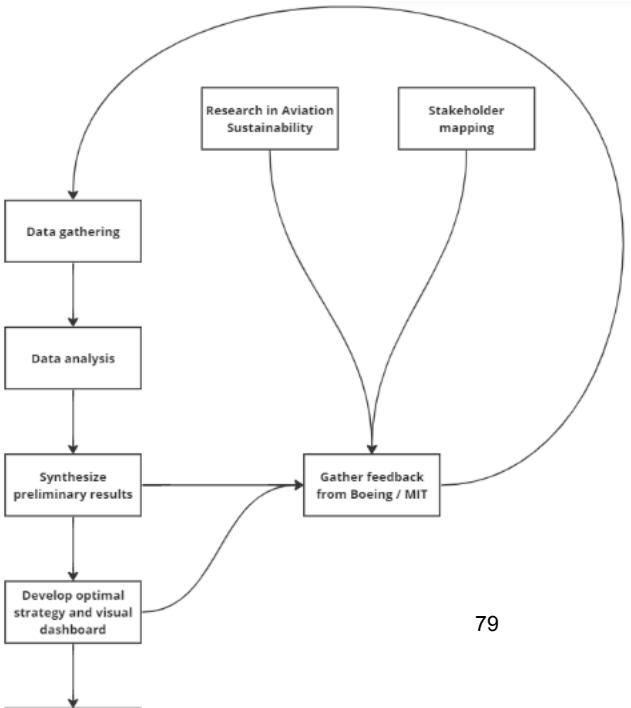
Sustainability is rapidly becoming a key requirement, and potential differentiator, in commercial aviation. This project will examine the current state of the art of quantifying and valuing sustainability measures in aviation. The main strategy to decarbonize aviation is to use sustainable aviation fuels (SAF) to lower emissions. Consequently, airfare may increase despite subsidies from government regulations since SAF is significantly more expensive than fossil fuels. This project will focus on the consumer's willingness to pay the SAF "green premium" and its impact on travel demand.

APPROACH

Boeing has access to flight fare and operational data, which will be enhanced by integrating other indicators such as GDP, population, oil prices, and more, in the process of constructing a machine learning model for predicting air travel. This model aims to estimate the elasticity of travel demand in relation to price fluctuations based on historical data.

DATA SOURCES

Data Types and Format



Author: Mark Membreno

IMPACT

This research is expected to reveal insights of how increases in airfare due to SAF could affect air travel. By identifying and quantifying which passenger segments, routes, and regions are more inelastic, Boeing can determine which groups are more willing to absorb fare increases. This research will help Boeing engage various stakeholders around SAF policy, regulation, and adoption. Ultimately, this will help Boeing lead the efforts to strategically scale up SAF adoption in identified markets while understanding the potential impacts on revenue and demand. The deliverables will be a calibrated model to predict air travel demand based on various factors such as region, route length, world oil price, SAF price, etc. The model can provide an optimal strategy to scale up SAF with the objective of maintaining a healthy air travel system against the constraint of net-zero by 2050. Furthermore, an interactive Tableau dashboard with sliders can be developed to explore sub-optimal but feasible scenarios to scale up SAF when talking with various stakeholders.

DRIVERS

BARRIERS

ENABLERS

ACTIONS

INNOVATION

IMPROVEMENT

BEST PRACTICES

OTHER APPLICATIONS

Reducing Cycle Time Variability In Aerospace Machined Components

BLUE ORIGIN

BUSINESS PROBLEM

Blue Origin is a private aerospace company working to increase access to space through reusable rockets. A focus area of the company is to vertically integrate the production of rocket engines, including the manufacturing of individual components; many of which require high precision machining. As such, great investments have been made to increase in-house machine shop capacity. With four (4) engines in different stages of the development lifecycle, the machine shops currently operate as high-mix, low-volume job shops with high variability in lead times and cycle times.

APPROACH

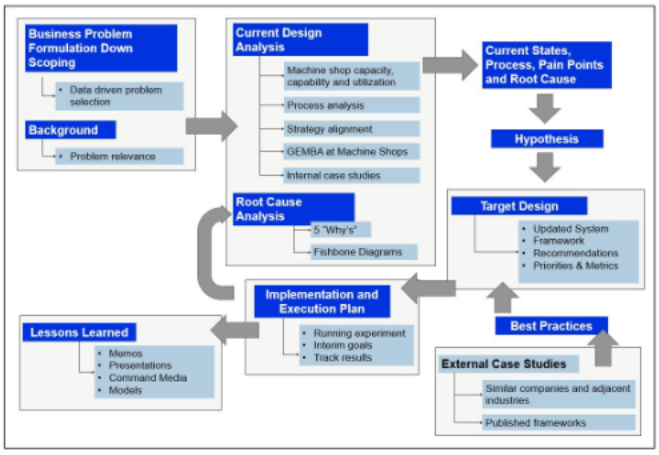
Blue Origin has an extensive amount of data from their engineering and manufacturing processes. The data will be used to understand machine shop operations and how parts are introduced. The goal is to identify pain points, bottle necks and sources of variation. Lastly, root cause analysis will be conducted to identify the sources and contributing factors to the business problem.

DATA SOURCES

Blue Origin captures its engineering, manufacturing and quality data digitally and maintains a cloud database. Processes and decisions are captured in meeting minutes, memos, and command media.

Data Types and Format

Engineering and manufacturing data can be accessed with SQL queries. The data is captured as lists and can be processed using Python or Excel.



Author: Blanca Murga

IMPACT

TBD

DRIVERS	TBD
BARRIERS	TBD
ENABLERS	TBD
ACTIONS	TBD
INNOVATION	TBD
IMPROVEMENT	TBD
BEST PRACTICES	TBD
OTHER APPLICATIONS	TBD

Fusion Reactor Maintenance Design Using the Design Structure Matrix and Radiation Transport Modeling

BUSINESS PROBLEM

Recent developments in High Temperature Superconducting magnets allow a novel, compact fusion reactor design, ARC, which will achieve positive energy production. However, a key to commercial success lies in the ability to rapidly replace components damaged during normal operation. Particularly, the Vacuum Vessel, at the core of the reactor, becomes highly radioactive and must be replaced. The purpose of this project is to scope the maintenance concept for ARC, ensuring that major trades are understood to allow future down-selections and to model the maintenance outage radiation environment.

APPROACH

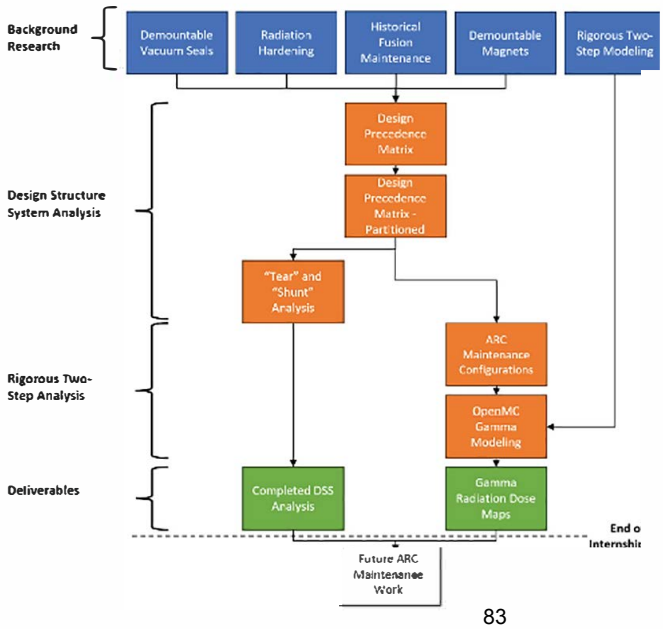
Using the Design Structure System, I will create a comprehensive approach to designing the maintenance for ARC. This approach allows the mapping of variable co-dependencies and methods to continue designing despite uncertainty in exogenous inputs. I will then conduct a rigorous analysis of one variable, the shutdown radiation environment, using the rigorous two-step method in OpenMC.

DATA SOURCES

Data sources for this project consist primarily of company research and development on reactor operating conditions and the CAD model. From there, I will generate the radiation transport models to conduct the analysis. Additionally, research on the academic literature will provide data to assess different design tradeoffs.

Data Types and Format

Existing CAD models of the reactor, known properties of the materials under consideration, and known plasma physics outputs are the data for this project.



Author: Dan Murphy

IMPACT

The result of this work will be twofold: first, to define the tradeoffs associated with fusion maintenance and, second, initial modeling of the radiation environment during maintenance. The impact of the first result will be to identify and sequence studies, work, and decision points in the design of the reactor as it applies to maintenance and as maintenance decisions apply to other design considerations. This will serve as the roadmap for future work in ARC maintenance design work. The impact of the second result will be inputs for requirement development. It is currently unknown what the radiation environment will be for the remote handling robotics. Once that is known, design work can continue, cost can be estimated, tradeoffs considered, and requirements set.

DRIVERS	**A commercial fusion power plant needs to maintain a high capacity factor to be financially viable. Therefore, the timeline of the outage must be minimized. If the reactor is designed without maintenance in mind, the outage duration will be longer than necessary. To ensure viability, maintenance must be a design consideration from the earliest stages.**
BARRIERS	**The largest barrier to the project is the nascent stage of the industry and the effort within the company itself. Almost none of the proposed actions have ever been done before, especially not on the timeline considered. The problem set was, therefore, undefined and nebulous. Adding clarity was made additionally difficult by short history of the team itself and other challenges with poorly defined requirements.**
ENABLERS	**The company's prior (and ongoing) work on its prototype, SPARC, enabled my work in some cases because there were limited parallels to my work. Additionally, my supervisor provided me a broad mandate but limited guidance which allowed me to explore multiple areas of the literature in an attempt to find all variables relevant to maintenance.**
ACTIONS	**The Design Structure Matrix will guide future maintenance design. Co-workers at the company are familiar with it and will continue the work beyond the internship.**
INNOVATION	**This application of the DSM to fusion maintenance is the first time such a process has been done in the field of commercial fusion maintenance. Future fusion efforts might benefit from the same variable identification, relationship mapping, and sequencing.**
IMPROVEMENT	**TBD**
BEST PRACTICES	**When confronted with a brand new problem set and serious ambiguity on how to proceed, the more time spent on literature review the better. In haste to show progress, many, myself included, many will start down a path too soon only to find out it's been tried or isn't relevant. A slower process of gathering information on previous efforts ensures a comprehensive approach on something actually usable.**
OTHER APPLICATIONS	**The approach is an example of Design Structure Matrix application to a complex design project. Anyone facing a similar problem set could learn from how it has been applied here.**

BERT-Driven Siamese Networks: Next-Best Article Recommendations for Enhanced Self-Service

Amazon

BUSINESS PROBLEM

AWS Support is presented with a great business opporunity: making customer self-service journey more efficient across its digital content platforms. Despite AWS Support's offering of a vast array of educational content, customers often struggle to find relevant solutions in an efficient and timely manner, leading to increased case escalations and reduced satisfaction. The goal is to enhance the self-service digital experience by offering customers a streamlined journey, leveraging machine learning driven recommendations based on content that customers already visited in a journey, reducing case volumes and elevating overall user satisfaction.

APPROACH

We will utilize a Siamese neural network, a specialized ML model that compares two inputs. Here, one input is a customer's already visited journey, and the other is a potential next article. By transforming articles into numerical embeddings using BERT, we determine how similar the potential article is to the current journey. The most relevant articles are then recommended.

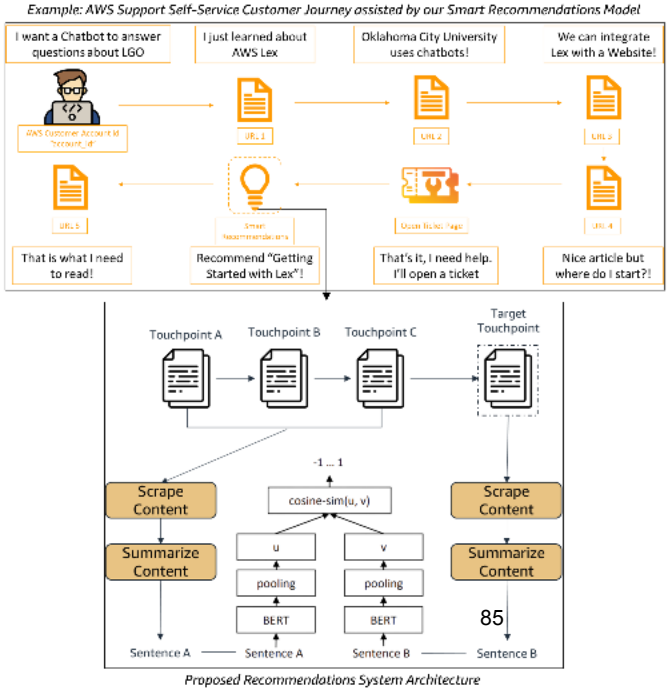
DATA SOURCES

Data is collected by AWS Support's digital platforms, capturing customer interactions with support content without the ability to identify the customer identity. All the interactions are captured in touchpoint format, a set of features that show the type of interaction a user had with the platform. All the touchpoints are saved using a batch process which stores them into a RedShift Cluster.

Data Types and Format

The collection of touchpoints is stored as table with fields containing information about these user interactions. The fields are of type String, Int, Float, Bool or Datetime.

Example: AWS Support Self-Service Customer Journey assisted by our Smart Recommendations Model



Proposed Recommendations System Architecture

Author: Teodor Nicola Antoniu

IMPACT

The implementation of the BERT-driven Siamese Networks for article recommendations is anticipated to revolutionize the self-service journey for customers interacting with AWS Support's digital content. Immediate impacts include: 1. Enhanced User Experience: Customers will experience a seamless journey, directed towards relevant articles based on their prior interactions, eliminating time-consuming searches and the associated frustrations. 2. Reduced Case Volumes: By guiding customers to the most pertinent solutions, the need to escalate issues to customer support will diminish. This not only saves costs related to case handling but also reduces the workload on customer service representatives. 3. Increased Engagement: Providing precise, relevant content boosts customer confidence in the platform, promoting prolonged engagement. 4. Optimized Content Strategy: The insights derived from the recommendation system can offer valuable feedback on which articles are most effective, allowing content creators to refine their strategies, ensuring the continuous improvement of the support material. 5. Financial Savings: A reduction in escalated cases directly translates to fewer resources being allocated to handle customer queries. 6. Scalable Solution: The model can continuously learn and adapt. As the content library grows and user behavior evolves, the system can be retrained to keep recommendations relevant, ensuring it remains effective over time.

DRIVERS	With the post-COVID era seeing a marked shift towards digital self-service, there's a need to guide users efficiently across AWS Support's thousands of support resources. Furthermore, the global trend towards data-driven personalization means today's users expect tailored experiences. Meeting these needs ensures enhanced customer satisfaction and support infrastructure scalability.
BARRIERS	The project faces several barriers. Customers engage with AWS Support platforms with a broad array of intentions, from browsing to troubleshooting or research, leading to diverse journey patterns. Moreover, our data capture is limited as we're unable to track interactions outside of AWS, leading to gaps in customer journeys. The absence of a system that offers real-time journey data adds complexity to production deployment.
ENABLERS	The steadfast support from our adept Applied Science teams proved invaluable, bringing technical acumen to the table. Active involvement from stakeholders ensured alignment of our objectives with broader business goals. The AWS Support product teams also collaborated with us, aiding in practical integration. Proactive managerial support was instrumental.
ACTIONS	To implement the solution, I first undertook rigorous exploratory data analysis to better understand the dataset's nuances. Key preprocessing steps were then mapped out, followed by conceptualizing the model architecture. To ensure structured progress, the project was segmented into tangible milestones, focusing on curating a 'golden' input dataset pivotal for training. Lastly, robust evaluation criteria and success metrics were established.
INNOVATION	The solution's innovation lies in its novel application of Siamese BERT networks for recommendation within support content. Unlike traditional systems, ours leverages sequential content interactions, capturing intricate user behavior nuances. By representing articles as embeddings, we address content size variability, ensuring model consistency.
IMPROVEMENT	The solution is anticipated to increase case deflections by guiding customers to pertinent content more efficiently. The proposed model aims to shorten the average customer journey length, enhance content engagement and positively impact overall user experience and support metrics.
BEST PRACTICES	To replicate this solution's results, ensure a clean and comprehensive dataset that accurately reflects user journeys. Utilize thorough exploratory data analysis to identify patterns and anomalies. Engage in consistent collaboration with stakeholders, ensuring alignment with project goals. Design a robust preprocessing pipeline for diverse content lengths.
OTHER APPLICATIONS	Our solution's emphasis on sequentiality offers rich applications, especially in shaping learning paths for educational content, ensuring step-by-step progression that aligns with learners' needs. Another application could be guiding users through intricate software or apps. The sequentiality innovation makes the model ideal for enhancing tailored content navigation.

Evaluating New Business Opportunities for Interregional Transmission

BUSINESS PROBLEM

Transmission is the single most important enabling technology for decarbonization. The large transmission projects that are critical to enabling access to renewable energy resources have generally taken 10-20 years to build. Once these projects are completed, the electricity landscape will look different due to projected high growth of electricity consumption and renewable energy generation through the next few decades. Therefore, it is important to leverage research-backed, modeled predictions of the electricity sector's future to assess transmission line's business viability on a forward-looking basis.

APPROACH

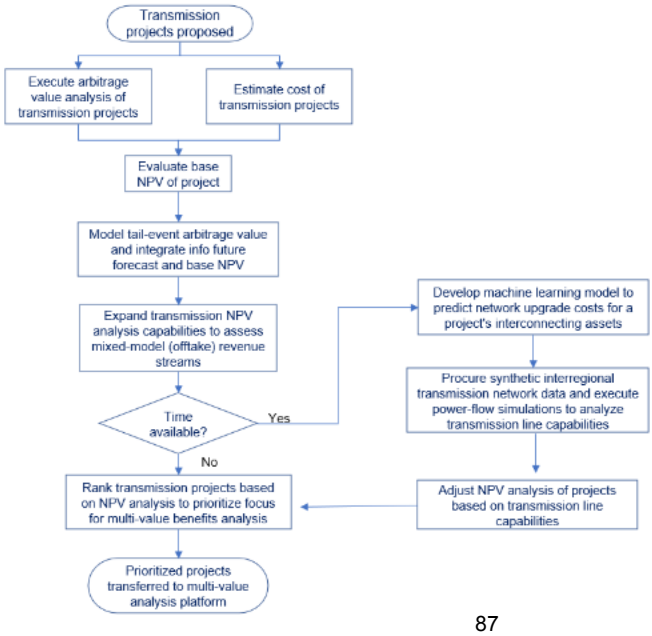
A transmission business assessment tool will analytically demonstrate the business viability of proposed interregional transmission projects through their useful lifespan. The tool will perform NPV analysis of the projects with input from modeled predictions of the electricity sector's future, historical electricity market volatility, and cost estimates of transmission infrastructure.

DATA SOURCES

Data of transmission project concepts was obtained through internal channels. Wholesale electricity prices was obtained through subscription-based data suite and public sources. Transmission asset cost estimations are obtained from public sources. Transmission capacity contracts are obtained through internal channels and public sources.

Data Types and Format

Transmission project, capacity contracts, and other proprietary data source formats are not able to be disclosed. Wholesale electricity prices and transmission cost are time and location series.



Author: Don Okoye

IMPACT

TBD

DRIVERS TBD

BARRIERS TBD

ENABLERS TBD

ACTIONS TBD

INNOVATION TBD

IMPROVEMENT TBD

BEST PRACTICES TBD

OTHER APPLICATIONS TBD

Logistics / Distribution | Retail | Inventory management / control | Deterministic / Stochastic

Building stochastic stock simulation for retail store operations

INDITEX

BUSINESS PROBLEM

For a brick-and-mortar retail business with omni-channel fulfillment, high sales velocity, product portfolio complexity, limited store capacity, and inherent demand stochasticity, agile store inventory planning is crucial to its success. To facilitate such agility in shipments, backstocks and transfers, this project aims to create a tool that simulates how these decisions directly impact store operations (i.e. capacity utilization and product complexity), in order to inform better store inventory planning.

APPROACH

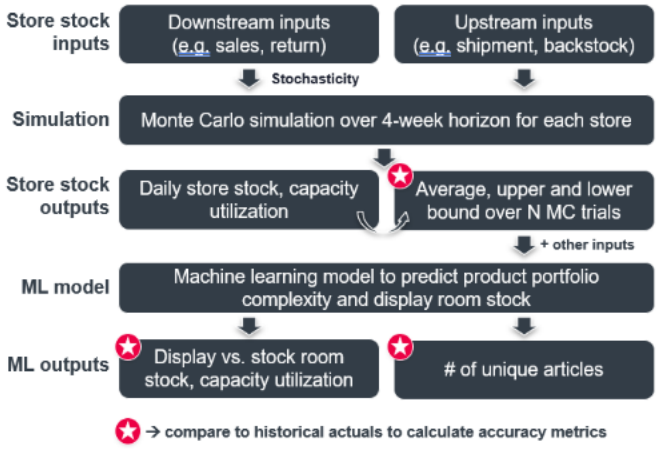
Store stock will first be simulated stochastically by reconstructing upstream (i.e. shipments, backstock) and downstream (i.e. sales, return) movements using Monte Carlo methods. Machine learning models will then take store stock outputs from the simulation and further predict display vs. stock room breakdown, as well as product portfolio complexity.

DATA SOURCES

Historical store volume flows, stock level, and downstream forecasts are the main data leveraged. All data are pulled directly from the enterprise data systems, using a combination of Scala, SQL and PySpark, enabled by Databricks. Additionally, institutional knowledge on the business rules for relevant operations are also leveraged to enhance simulation fidelity.

Data Types and Format

Volume flows, stock level and forecasts are all provided as time series.



Author: Davy Qi

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

Supply chain planning and inventory management | Transportation and logistics | Inventory management / control | Reinforcement Learning

Simulating and Improving Middle Mile Inventory Management Policies

BUSINESS PROBLEM

As digital consumer demand has grown, Nike has had to adapt its supply chain. Nike's new network, which includes regional service centers and an inbound sortation center, was created to help accommodate digital demand, but a key question remains: how to best position inventory within the network. Each day, stock transfer orders dictate where SKUs should be sent, and how much. A third-party middle-mile decision engine generates these STOs, but for Nike to simulate end-to-end supply chain runs within a digital twin framework, an in-house emulation of this decision engine is needed. I am building the emulator and testing RL algorithms.

APPROACH

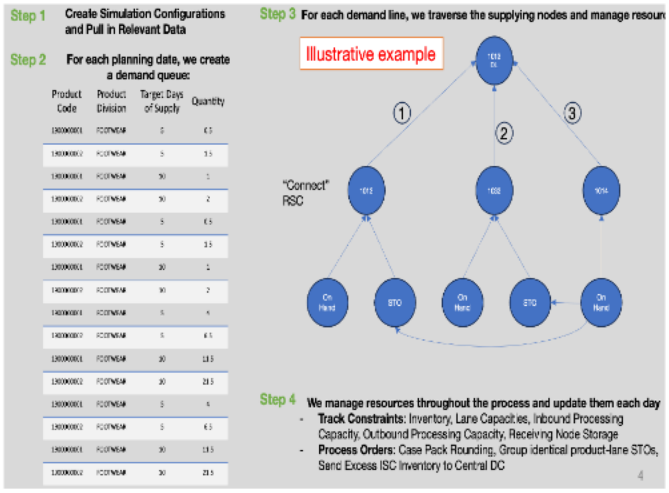
We built an emulator of the third-party middle mile decision engine using python and SQL. We ingress data from other teams, such as forecasts, capacity constraints, initial inventory positions, and more, and then we proceed with a heuristic greedy allocation algorithm which matches the logic of the production system. I am building a reinforcement learning environment to test new policies as well.

DATA SOURCES

Future demand estimate data gets pulled in from the forecasting team. Data related to the network configuration, which includes lane priorities, lane costs, capacity constraints, initial inventory, lead time estimates, incoming purchase orders, etc. comes from SQL tables different parts of the business maintain. I simulate data as well for the reinforcement learning approach.

Data Types and Format

Time Series JSON Object for configuration



Author: Matthew Robins

IMPACT

TBU

DRIVERS

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BARRIERS

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ENABLERS

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ACTIONS

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INNOVATION

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IMPROVEMENT

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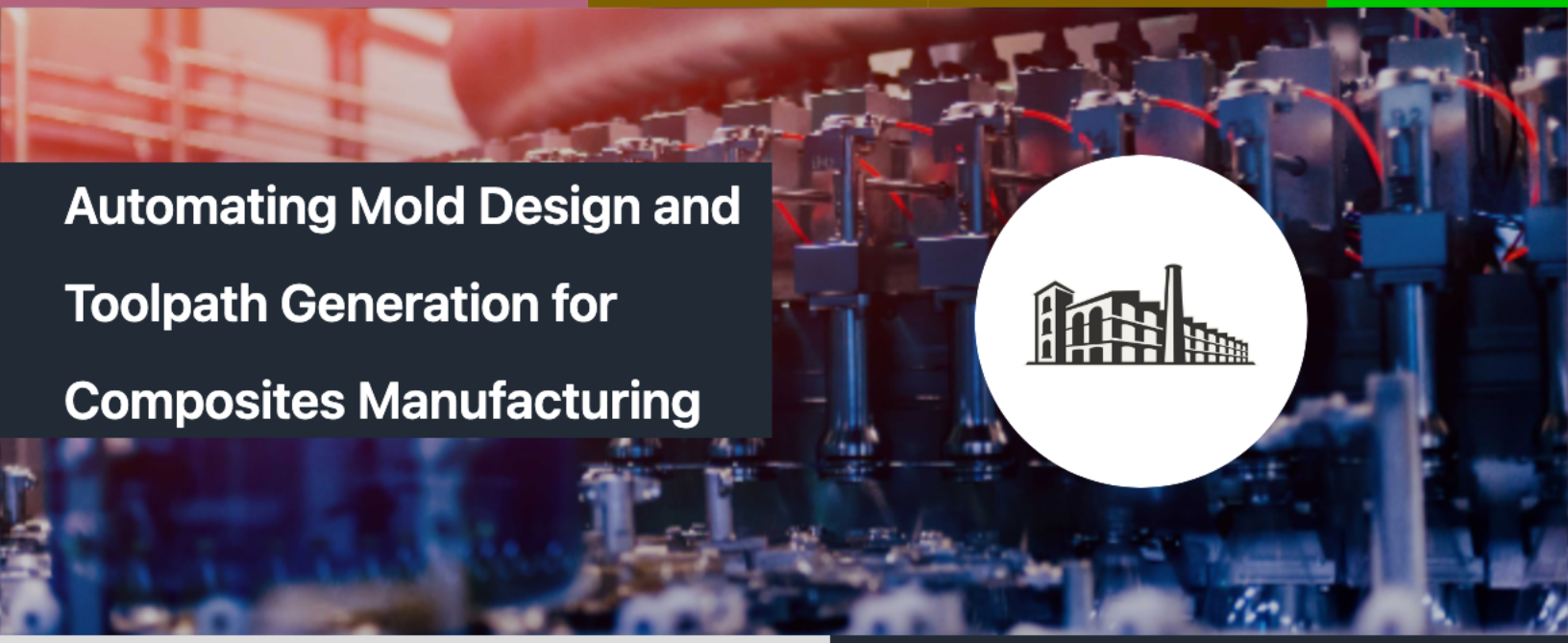
BEST PRACTICES

TBU

OTHER APPLICATIONS

TBU



Automating Mold Design and Toolpath Generation for Composites Manufacturing

BUSINESS PROBLEM

As Re:Build Composite Resources (CR) pursues growth goals, project engineers will play a critical role. The existing project engineer workstream consists of high-value decision-making and low value repetitive tasks, including the design of molds for simple geometry parts. The goal of this internship project is to automate mold design and toolpath selection for simple geometry composite parts. This will reduce lead times, increase project engineer capacity, reduce indirect labor costs, and standardize engineering outputs.

APPROACH

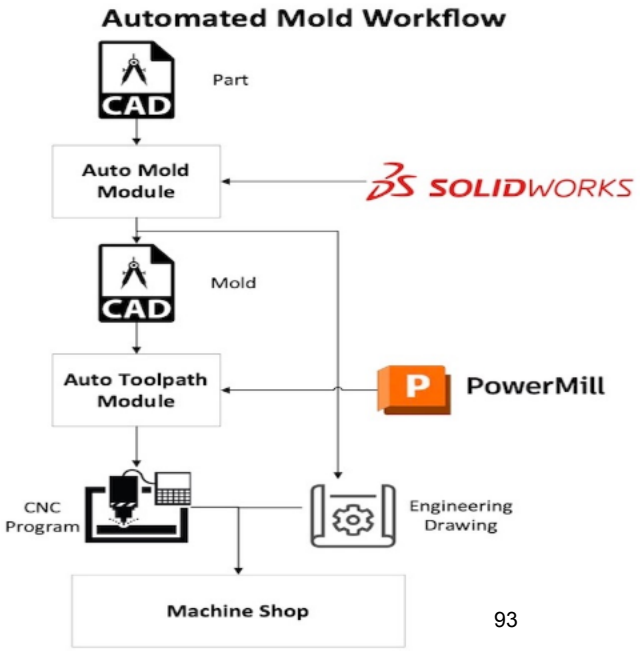
Historical parts were studied to qualitatively define in-scope parts based on geometric complexity. The manual mold design and toolpath selection processes were mapped. Using a combination of CAD/CAM API calls, engineering heuristics, and rules based decision making, a suite of C# and Python based algorithms were iteratively developed to automate mold design and toolpath selection.

DATA SOURCES

Mold data was gathered by qualitatively analyzing CAD files. Toolpaths were characterized by scraping thousands of CAM files and extracting toolpath parameters. ERP entries were collected and analyzed via SQL queries. Engineer/ CNC programmer interviews were conducted to understand technical decision making. Management interviews were conducted to understand greater business context.

Data Types and Format

CAD/ CAM files, aggregate toolpath parameters, ERP data including work center processing times and PO frequency, and text from interview notes.



Author: Mark Sweet

IMPACT

TBD

DRIVERS

TBD

BARRIERS

TBD

ENABLERS

TBD

ACTIONS

TBD

INNOVATION

TBD

IMPROVEMENT

TBD

BEST PRACTICES

TBD

OTHER APPLICATIONS

TBD

Logistics / Distribution | Transportation and logistics | Predictive forecasting | Regression analysis

Data Roadmap for Amazon Last Mile Sustainability

Amazon

BUSINESS PROBLEM

In 2019, Amazon signed a climate pledge to reach net-zero carbon emissions by 2040. Amazon's last mile delivery team (AMZL) is focusing on various initiatives such as use of electric vehicles for delivery and powering delivery station operations with 100% renewable energy. The AMZL team is pursuing a mechanism to measure accuracy of carbon data inputs and existing forecasts. This internship focuses on developing a monthly carbon emission forecasting model and proposing a data roadmap to improve forecast accuracy.

APPROACH

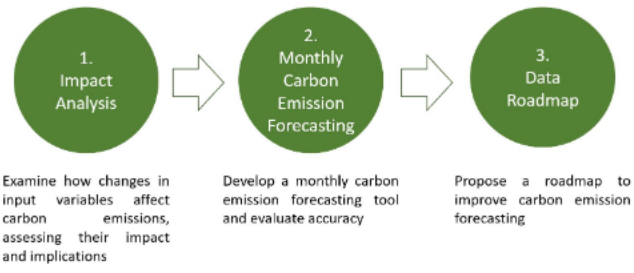
This project will study variable impact analysis to understand impact of contributing variables on carbon emissions. A monthly carbon forecasting model will then be built, evaluating its accuracy, and identifying sources of variability. Recommendations on areas of improvement for carbon forecasting process at AMZL will be summarized in a report.

DATA SOURCES

Carbon emission forecast input variables are last mile activity related parameters. Access to required data of input variables is provided by involved stakeholder teams.

Data Types and Format

Most of the data is stored in Amazon's data cluster, which will be accessed using SQL queries. Some of the data is shared by teams in Excel spreadsheets.



Author: Sajiree Vivek Vaidya

IMPACT

Placeholder

DRIVERS

Placeholder

BARRIERS

Placeholder

ENABLERS

Placeholder

ACTIONS

Placeholder

INNOVATION

Placeholder

IMPROVEMENT

Placeholder

BEST PRACTICES

Placeholder

OTHER APPLICATIONS

Supply chain planning and inventory management | Healthcare / Pharmaceuticals | Inventory management / control | Discrete / Continuous

Developing a Digital Twin to Optimize the Supply Chain and BCP Design of Medical Devices

AstraZeneca

BUSINESS PROBLEM

Supply chain disruptions are becoming increasingly common as a result of geopolitical and environmental events, making it harder for the company to comply with their zero stock out policy within an industry where demand is already highly uncertain. For a particular brand portfolio, the company wants to ensure they can uninterruptedly serve customer demand for up to six months after a disruption occurs at any supply chain node up to their second-tier suppliers. To test such resiliency under different conditions and stress scenarios, the company aims to have a digital twin that allows them to simulate the supply chain and identify risks.

APPROACH

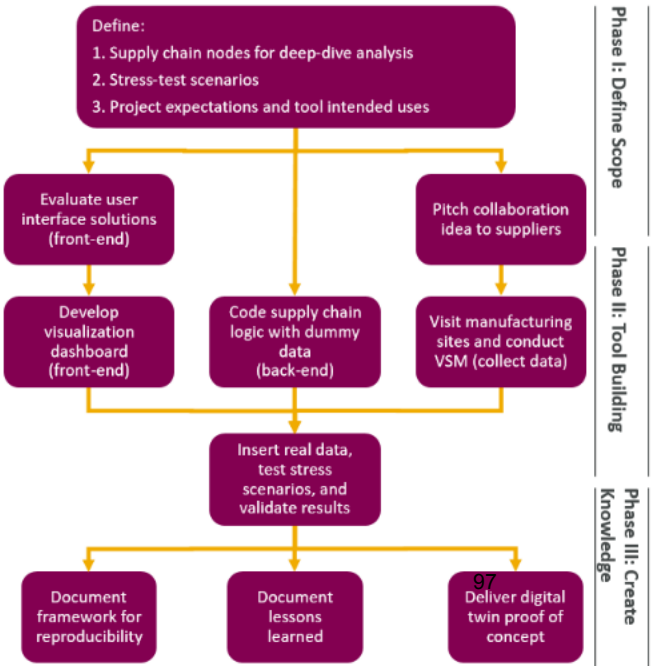
First, define the supply chain boundaries for the model. Select nodes that will be detailed and those that will have assumptions. Then, collect data for detailed nodes. Schedule visits to external and internal manufacturing sites in focus to map their processes. Last, develop proof of concept for the digital twin (front + back end), test stress scenarios, provide insights and document learnings.

DATA SOURCES

Data for the project comes from internal and external sources. Internal data is mainly kept on spreadsheets or interactive dashboards that contain historical data (time series), but lacks structure and each is owned by a different team. External data was manually collected on spreadsheets by surveying the relevant suppliers.

Data Types and Format

Most of the data is kept an operational data hub and is then visualized in business analytics dashboards. Spreadsheets are the most common format for data sharing and data manipulation.



Author: Carlos Vela González

IMPACT

TBD

DRIVERS	TBD
BARRIERS	Many suppliers try to protect their data and are hesitant to share too many details. Explaining the benefits they may get out of the project helped, but tangible results seem to be required to obtain full collaboration.
ENABLERS	The cultural approachableness at the company facilitates collaboration among peers. It is easy to get a meeting with almost anyone at the organization and everyone is always willing to help.
ACTIONS	TBD
INNOVATION	TBD
IMPROVEMENT	TBD
BEST PRACTICES	TBD
OTHER APPLICATIONS	TBD

Scaling metal additive manufacturing from R&D to production

AMERICAN INDUSTRIAL PARTNERS

BUSINESS PROBLEM

Rapidly growing an AM business requires both (i) winning substantial customer orders as well as (ii) operating with excellence to deliver on those orders. Limited operational or technical data has been collected by the company thus far. As a result of that, there is no significant track record of e.g., material testing, and customers increasingly demand traceability and certification of material and parts. Additionally, limited operational data has been collected which is critical to control and to understand how to grow the business effectively. Main needs are capacity and resource planning as well as business control on a per-order basis.

APPROACH

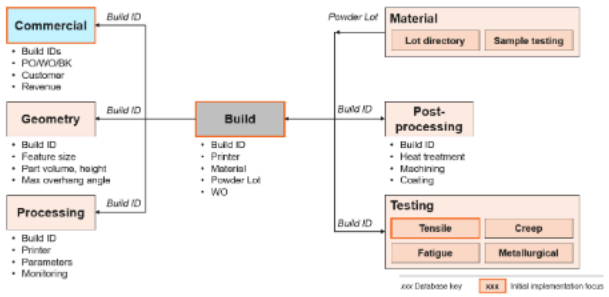
The central element is a holistic data strategy and architecture for a data warehouse. Within the time frame of this project, the two most critical elements of this strategy will be implemented: the material test database for tensile testing as well as a build log connecting commercial with technical data per 3D printing build to allow for operational planning.

DATA SOURCES

ERP data, CRM data, Accounting/Financial data, Machine data, Mechanical/Material test reports, Misc operational documents (e.g., work order travelers, purchase orders, quotes, invoices), Employee testimonials, 3D models/part files and AM build files

Data Types and Format

Numerical data, Strings and text documents, Time series, Images, Spreadsheets, CAD/CAM files



Author: Reimar Weissbach

DRIVERS	Placeholder
BARRIERS	Placeholder
ENABLERS	Placeholder
ACTIONS	Placeholder
INNOVATION	Placeholder
IMPROVEMENT	Placeholder
BEST PRACTICES	Placeholder
OTHER APPLICATIONS	Placeholder