

# Decision Sciences at Air Products

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*Editor's note: This is the first in a series of articles profiling members of the INFORMS Roundtable.*

## Company Background

Air Products serves customers in technology, energy, healthcare and industrial markets worldwide with a unique portfolio of products, services and solutions, providing atmospheric gases, process and specialty gases, performance materials and chemical intermediates. Founded in 1940, Air Products has built leading positions in key growth markets such as semiconductor materials, refinery hydrogen, home healthcare services, natural gas liquefaction and advanced coatings and adhesives. The company is recognized for its innovative culture, operational excellence and commitment to safety and the environment, and is listed in the Dow Jones Sustainability and FTSE4Good Indices. The company has annual revenues of \$8.1 billion, operations in more than 30 countries, and has more than 20,000 employees around the globe.

Air Products is more than halfway through a multi-year effort to implement a single global instance of SAP, a business information platform and accompanying global work process that will make it One Company in the eyes of its customers. In other words, Air Products will have one set of business processes for its global businesses and standardized documentation for all its products and businesses. SAP will serve as the backbone for all business transactions and will provide a central repository of data.



## Introduction

The Decision Sciences (DS) function at Air Products is recognized as a core competency and operates as a center of excellence for operations research/management sciences services within the company. The DS team has a long history of nearly 40 years successfully providing analysis and implementing O.R. solutions in all the company's major business areas and many of the enabling corporate functions. The DS team operates as an internal consulting group, partnering closely with key business decision-makers. This partnership ensures that the DS team understands the business activities, strategies and challenges in order to provide the analytical support necessary to help the corporation succeed. The operations research tools and models developed by this team are being used in planning, manufacturing and distribution activities around the world. Applications developed by Decision Sciences have contributed an estimated cost savings of more than \$75 million cumulatively over the past 10 years.

Air Products has been a charter member of the INFORMS Roundtable since 1982 (see sidebar).

The Air Products Decision Sciences group was the recipient of the 1983 TIMS Management Science Achievement Award (predecessor of the Edelman Prize) and the 2005 INFORMS Prize.

Four primary factors have contributed to the success of the Decision Sciences group over the years: developing a strong staff, positioning of the group within Information Technology, partnering with internal business clients and leveraging external resources.

## The DS Staff

The Decision Sciences staff is a diverse group of highly skilled operations research professionals. The team is currently comprised of 17 individuals with an average of more than 12 years of industrial experience, ranging in duration from one to 30 years. The vast majority of the team members have earned advanced graduate degrees in operations research, engineering, mathematics or business administration from a wide range of prestigious universities. Team members are located in both the corporate headquarters (Trexlerstown, Pa.) and the European head-

quarters (Hersham, U.K.). The DS team currently spends its time developing new models, providing consulting and analysis, and researching new techniques and areas of opportunity.

## Positioning of the Group within Air Products

The DS team is positioned within the Global Information Technology (IT) organization at Air Products. It has consistently received strong support and encouragement from senior management. The team has been granted the necessary degrees of freedom that provide the flexibility to pursue new opportunities to apply O.R. techniques within the company and explore the applicability of new O.R. technologies to industrial and commercial problems. As a result, the members of DS remain current in the latest techniques, work in support of the IT and business strategies, and proactively pursue high-value projects that utilize their skills.

Close alignment between key internal business clients and members of the Decision Sciences staff has been instrumental in identifying effective ways to leverage O.R. techniques for high-impact results. As an example, the DS team has worked closely with the internal SAP implementation team to help configure the Advanced Planning and Optimization (APO) module for the business area. The APO module includes O.R.-related functions (demand forecasting, supply network planning and detailed production scheduling) and allows for the addition of custom heuristics. Also, the DS team partners with the extended supply chain organization within the company to define ways to implant O.R.-based solutions across the enterprise. At times, this also includes influencing business area work practices to make the best use of the IT tools, the O.R. functionality, and to align with other processes in the supply chain.

## External Partnerships

The DS team maintains external partnerships with universities, consultants and the INFORMS technical society. The group has worked with Carnegie-Mellon University, Lehigh University, Cornell University,

Princeton University and the University of Pennsylvania in areas such as enterprise-wide optimization, production and vehicle scheduling, and inventory management. The DS team has also partnered with external consulting companies such as Sabre Decision Technologies, Princeton Consultants and Accenture to develop in-house logistics and supply chain applications.

## DS Project Work

A great deal of recent project and consulting work in Decision Sciences has been focused on modeling the supply chains for the various business areas within Air Prod-

ucts. One area where the Decision Sciences group has had widespread success is network optimization defined as the design of a supply network from raw materials through production and distribution of the finished product, possibly via intermediate storage facilities, onward to the end customer. Since Air Products produces and distributes very large quantities of materials each year, a tool to optimize, evaluate and monitor the supply chain network is crucial.

The Decision Sciences team's initial foray into modeling of a supply network occurred almost 40 years ago at Air Products, with a focus on the North American

## All About the Roundtable

INFORMS has two types of members: individual and institutional. To join INFORMS, an organization joins the INFORMS Roundtable and appoints as its representative the person in overall charge of O.R. The Roundtable has been a very active group since its founding in 1982, with three meetings each year and much communication in between.

The Roundtable, its members and its member representatives take a strong interest in how INFORMS serves the needs of practitioners, and have undertaken many initiatives and provided many services toward this end. These involve, for example, public awareness of O.R., both of the annual INFORMS conferences, continuing professional education, one of the prizes and various committees. In addition, the Roundtable has an advisory responsibility to INFORMS.

One bylaw states that it "... shall regularly share with INFORMS leadership its views, its suggested initiatives and its implementation plans on the important problems and opportunities facing operations research and the management sciences as a profession and on the ways in which INFORMS can deal proactively with those problems and opportunities ..." By tradition, it meets with the newly elected INFORMS president-elect each spring to discuss practice-related topics of interest to him or her, and with the entire INFORMS Board each fall to discuss topics of mutual concern.

The Roundtable membership comprises 45-50 institutions - mainly industrial, but also educational, governmental and vendor. This series of articles aims to share with the INFORMS membership at large some information and insights into how O.R. is carried on in practice today.

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liquid oxygen and liquid nitrogen production and distribution network. The technology was mainframe-based, using a FORTRAN matrix generator and the IBM MPSX optimizer. The models were run by members of the O.R. team and would take hours to solve. Today the supply chain network optimization models are global in scope, user-run, server- and PC-based and have graphical output. Data is automatically fed from the corporate SAP databases. The models are larger, more complex and take minutes to solve.

The current network optimization models are used by supply chain planners in the business areas. Supply chain planners making operational and tactical decisions work jointly with Decision Sciences in defining the models specific to their business and in resolving operational infeasibilities. These planners use the results from the models to evaluate facility locations and capacities, and determine customer sourcing assignments and optimal material flow through the network. Improvements have been realized in terms of reducing the number of miles driven, increasing average delivery amounts, improving customer service metrics, improving inventory costs and determining optimal distribution center locations.

In support of the company's logistics activities, DS has developed both tactical planning and operational scheduling tools to address resource allocations, inventory policies, customer segmentation and customer product consumption forecasting. The DS team has also created operational level tools for near-term forecasting and delivery scheduling for the liquid and cylinder gases areas. The results include more effective use of resources, efficiency improvements leading to increased margins, and improved responsiveness to spot demands and unanticipated disruptions.

The DS team also has a wide range of applications utilizing simulation. Over the years, DS has used simulation

models to analyze product flow through Air Products' chemicals and equipment manufacturing facilities, locate new facilities, justify capital expenditures, streamline distribution networks, investigate supply chain dynamics and evaluate product offerings. The DS team has combined simulation with decision analysis, optimization and game theory techniques to evaluate new business ventures.

The implementations of network optimization, logistics and simulation tools for various business areas have each been valuable in their own right. The greater benefit, however, has been realized when DS was able to integrate these models. The ability to provide a suite of applications that cover the full range of planning horizons has entrenched O.R. techniques into the business operations and decision-making. Air Products' move to One Company with global business processes enabled by a single instance of SAP was the catalyst for these implementations that cross business areas.

In addition to developing supply chain decision support models that are used on an ongoing basis, another very important contribution is the group's internal consulting activities. The group provides quick-hit analysis to address unplanned, opportunistic business problems. The team provides this analytical decision analysis across the corporation.

## Lessons about Successful O.R. Application

Key lessons have been learned over the years that are fundamental to the success of the O.R. function at Air Products. Since the DS group is part of the IT organization, the group is able to easily embed O.R. models within IT applications. This has allowed the group to focus team members' energies more on the modeling and less on traditional IT development. The greatest successes have come when the DS team has been involved in a project from the very beginning. This is true for both IT and business area driven efforts.

Decision Sciences team members are very analytical thinkers with a great deal of practical experience, and many have an engineering background. As a result, they can combine a strong understanding of business area operations and O.R. skills to create powerful value-add solutions. Decision Sciences is very closely engaged with their internal clients. Members of DS work with them on a daily basis, participate in their meetings, and help define and prioritize additional ways in which the DS team could help them. Over the years, several members of the DS group have moved to key positions in the business and IT, and have become key internal clients. It is very important that the DS internal clients understand what the O.R. model is providing, how it contributes to their business area, and then realize the benefits in terms of either reduced costs or improved productivity. Decision Sciences' ability to consistently deliver results has been the greatest catalyst for generating new work.

## Summary

The Decision Sciences group at Air Products has a long recognized history of providing critical solutions and analytical consulting across the enterprise that have contributed to significant cost savings to the company. The DS team has become an integral part of how the company manages and operates their various businesses at the strategic, tactical and operational levels and is well positioned for continued success in the future.

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