Center for Excellence in Logistics and Distribution (CELDi)

A National Science Foundation sponsored Industry/University Cooperative Research Center (I/UCRC)
CELDi is a university-based enterprise providing innovative solutions for logistics and distribution excellence with our member organizations.

Six Research Universities

University of Missouri

University of Arkansas

California

Virginia Tech

Clemson University

More than 25 member organizations

Bayer CropScience

Leggett & Platt

Sams Club

entero

invistics

MO DOT

United States of America

Medical Center Hospital

Pensacola

National Science Foundation

(NSF I/UCRC)
What is a CELDi Partnership?
CELDi Mission:

CELDi has the mission of enabling member organizations to achieve logistics and distribution excellence by delivering meaningful, innovative and implementable solutions that provide a return on investment.

CELDi in-context projects achieve:

- Solving real problems that achieve bottom-line impact
- Graduating students with real-world project experience
- Sharing research results amongst member organizations to leverage intellectual and monetary capital
- Producing generalized, cutting-edge research that is published in leading journals
CELDi Memberships offers:

- Development of an in-context project to solve your problems
- Your employees collaborate directly with university research teams
- Gain direct access to other CELDi students and researchers
- Benefit from shared research solutions and tools
- Your employees enhance their career development with CELDi
Additional Benefits of Membership

- Meeting Attendance:
  - Student interaction
  - Exposure to new research
  - Managerial short courses
  - Peer networking
  - Center-Designated Project (CDP) selection

- Center-Designated Project (CDP) Deliverables

- Access to IP on All Projects
CELDi Provides:
Return on Investment for your time

What some IAB members had to say about the value of CELDi meetings:

- “I was impressed by the quantity and quality of the projects. I found two other projects that we can likely take advantage of in our company.”
- “I took away 4-5 potential ideas to go forward with to the company.”
- “I found four things to take back that will require us to think outside of the box.”
- “Really enjoyed the speaker’s talk - spoke to leadership.”
Current Center Designated Projects

Development of Logistics Efficiency Metrics

Supply Chain Networks Simulator Using Cloud Computing

Congestion-Based Design of Supply Chain Networks

Integrated Freight Consolidation & Shipping Models in International Supply Networks

Decision Support for Warehouse Design
Member Access to CELDi Products

- Login Page
- Project Descriptions and reports
Managing Disruptions in Pharmaceutical Supply Chain Networks

Mustafa Sir (University of Missouri)
Sarah Root, Ed Pohl (University of Arkansas)
Scott Mason, Kevin Taafffe (Clemson University)

KEY QUESTION
How can healthcare providers minimize the risk posed to patients while controlling the costs associated with production and delivery?
KEY QUESTION
How should a optimized biomass logistics system be designed with respect to the multiple stages of decision-making required for infrastructure investment and operations.
The MU team:

- 9 industrial engineering faculty
- 5 transportation systems engineering faculty
- 2 management logistics faculty
- 1 health management faculty
- 1 forestry faculty
- 3 agricultural engineering / economics faculty

Research Focus:

“An integrated approach to both facility and large scale logistics system challenges through modeling, analysis, and intelligent systems technologies.”
CELDi Focus Areas

Logistics Systems Analysis and Design

Material Flow Design & Improvement

Supply Chain Modeling

Intelligent Systems
We are exploring component repair and distribution facility location in order to minimize cost and time performance with respect to capability, capacity, and other constraints.

**Problem context**

**Broader Applicability**
- Design of reverse logistics networks for a wide range of maintenance operations
- Scenario analysis to explore cost – time performance trade-offs

**Business and project objectives**
- Evaluate maintenance facility location & transportation cost versus service time trade-offs
- Determine key problem constraints
- Network design within a Performance-based Logistics (PBL) environment

**Important/Expected Results**
- Maintenance location strategy to support PBL
- Reverse logistics network evaluation tool
  - Network configuration
  - Network operation
An Inventory Replenishment Strategy Using International Shipment Consolidation
Research Team: Wooseung Jang (PI), James Noble, Na Deng

**Sponsor:** Leggett and Platt, Inc.

**Problem in context:** Each branch of Leggett & Platt places orders to China independently. They have low order frequencies and high inventory. Coordinated inventory replenishment strategy will reduce inventory a lot. The project is to minimize the total cost by consolidating small international shipments when the coordinated inventory policy is taken.

**Important/Expected Results**
- Coordinated inventory replenishment and shipment policy for international logistics network
  - Shipment assignment
  - Inland transportation mode selection
  - Reduced inventory levels
  - Reduced cycle time
  - Increased flexibility

**Technical Approach**
- Analyze purchase order history data of each branch
- Improve current logistics network
- Formulate a mathematical model
  - Solution algorithms
- Test various scenarios
- Develop feasible implementation practices

Logistics Systems Analysis and Design
University of Missouri

China
North America
Optimizing MoDOT Winter/Snow Removal Operations
Sponsor: Missouri Department of Transportation
Research Team: W. Jang, J.S. Noble, C.J. Nemmers

Research Objectives:
Develop an integrated systems, optimization based approach to winter road maintenance planning decisions

Approach:
1) Develop a protocol for determining the desired level of service and the required constraints.
2) Develop an integrated model and efficient algorithms for large scale applications.
3) Validate the model/algorithms and apply results to the state of Missouri.

Broader Impact:
An integrated model that can be applied to a wide range of DOT operations (e.g. snow removal, pavement striping, herbicide application).

Significant Results:
Able to maintain current high level of service with fewer resources (20-30% savings)
On Demand Logistics System Design
Bayer CropScience
Research Team: M Sir (PI), J Noble, P Wutthisirisart, M Pariazar

We are developing decision-support tools to support the overall logistics / supply chain design for Bayer CropScience’s new On Demand treatment delivery system

Business and project objectives
• Supporting product launch of a revolutionary new seed treatment system
• Analyze projected product demand network.
• Develop data visualization tools for scenario analysis.
• Develop optimization tools to support design of supply chain network – both product and reverse logistics.

Important/Expected Results
• Tool to support configuration of supply chain network
• Software to optimize production and transportation
• Multi $M transportation, inventory and facility savings over product life-cycle
Supply Chain Design for Energy Conservation
Research Team: James Noble (PI), Wooseung Jang,

**Sponsor:** The Boeing Company

**Problem in context:** Overall supply chain performance is impacted by energy cost which has significantly increased in the past 10 years. Supply chain decisions such as supplier and mode selection, routing, inventory profile and load consolidation, can all be impacted by energy cost.

**Important Results**
- Identification of key supply chain trade-offs with respect to energy issues
- Development of supply chain reconfiguration approaches as energy cost changes
- Reduced overall supply chain cost
- Design of more robust supply chains from an energy consumption perspective

**Technical Approach**
- Supply chain and transportation data collection
- Supply chain evaluation model development
- Formulation of energy based supply chain optimization models
- Solution algorithm development
- Model sensitivity analysis
- Supply chain reconfiguration strategies
Demand Forecasting Models for Dynamic Material Requirements
Research Team: Wooseung Jang (PI), James Noble, Matt Roman, Na Deng

**Sponsor:** Ameren UE  
**Thrust Area:** Inventory  

**Problem in context:** Thousands of transformers across several different storerooms are used by Ameren every year. These transformers consist of hundreds of different types with widely varying individual demands.

**Important/Expected Results**
- Production of accurate forward looking forecast results  
- Creation of a forecast that can be easily applied when scheduling production slots from vendors  
- Increase in customer satisfaction by limiting monthly stock outs over a 1 year planning horizon

**Technical Approach**
- Examine existing problem  
- Gather relevant data  
- Analysis of historic usage data  
- Aggregate similar groups of transformers and choose individuals to forecast  
- Review different forecasting techniques used on similar demand  
- Create forecasting algorithm  
- Evaluate forecast accuracy

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**Total Usage Seasonality**

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Supply Chain Modeling  
University of Missouri
We are developing decision-support tools to identify opportunities to improve the logistics operations of the Bayer CropScience Kansas City Plant

Problem context

Broader Applicability

- The trade-off between onsite warehousing vs. off site warehousing through 3PLs is an important consideration for many companies.
- Warehouse capacity and material handling analysis.
- Decision-support tools using Microsoft Excel/Access.
- Cost-benefit analysis of various alternative scenarios.

Business and project objectives

- Analyze current state-of-the-art material flow models.
- Analyze the current material flow/inventory situation.
- Develop a set of material flow improvement alternatives.
- Evaluate the material flow improvement alternatives with respect to the trade-offs between performance and cost.

Important/Expected Results

- Capacity planning for off site and on site warehousing.
- Identification inefficient material handling practices.
- Graphical representation of alternative material flows
- Alternative material flow and allocation strategies
- Estimated annual transportation, material handling and space savings of $2.8M over 3 years
Problem in context: Hallmark Cards operates a very large distribution center (> 80k SKU and 220M items/year). The project objective is to develop a user-friendly warehouse floor layout tool that addresses the trade-offs between picking, stocking, shipping and retail stocking costs in order to reduce overall operating cost.

Technical Approach
• Analyze current Hallmark warehouse picking and stocking practices and supporting data.
• Analyze current filling floor layout practices and develop performance metrics.
• Formulate and analyze an integrated warehouse layout model.
• Develop a user-friendly warehouse floor layout tools and provide database integration support.

Important/Expected Results
• Effective and efficient methodology for optimal filling floor layout.
• Significant cost savings through explicit analysis of cost trade-offs between picking/stocking/shipping.
• Effective implementation strategy for filling floor relayout timing.
• Company specific project that exceeds $60K for one year buys a 1 year membership in CELDi
  – Involves a faculty member and at least 1 graduate & 1 undergraduate student
  – Single project or sequence of projects in phases

• NSF Role
  – Provides $50K per year for center administration
  – NSF requires each university to cost share => no overhead

• Members agree to share the fundamental research component of the projects with the other members
  – Confidential remains confidential
  – Companies review all documents before they are released and the university works to develop a version that is acceptable to both the company and CELDi
CELDi provides creative, leading-edge solutions to real-world problems:

- Member organizations collaborate with research teams
- CELDi is a collaborative enterprise that provides access to students and researchers
- Member organizations benefit from shared research solutions
- Members enhance their career development with CELDi