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ABSTRACT

Minnesota high school students and teachers are learning the technology of simulation and integrating it into business and industrial technology courses. Modeling and simulation is the science of using software to construct a system within an organization and then running simulations of proposed changes to assess results before funds are spent. In partnership with PROMODEL Corporation, the Southeast Service Cooperative is helping schools and communities in primarily rural southeast Minnesota to develop partnerships that make local businesses more globally competitive. School teams work with a local business or agency to identify a system that the organization wants to analyze. It may involve solving an operational problem, designing a new facility, or simply exploring possible improvements. The team compiles data from the partner to construct an animated model of the system and then runs "what if" simulations. Students develop a variety of communication, research, and technology skills, as well as an understanding of their community's economic development. Teachers can integrate the program into existing classes or offer it as a separate class. This paper describes how a modeling and simulation project might work, lists hardware and software requirements and costs, briefly profiles school-community projects in Minnesota small towns, outlines program benefits and relevance to Minnesota graduation requirements, and provides contact information. A Power Point slide presentation provides additional information. (SV)

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Southeast Service Cooperative

# Modeling and Simulation:

## PowerBoosting Productivity with Simulation

ED 438 131

## What's It All About?

**Call it art or call it science...**High school students and teachers are learning the technology of simulation and integrating it into both business and industrial technology courses.

Modeling and simulation is the science of using software to construct a system within an organization, such as the teller system in a bank, the assembly line of a manufacturer, or the product shelving and inventory in a grocery store. Running simulations of proposed changes to the system, the results can be analyzed *before* funds are expended to actually make changes. It is used extensively in the fields of healthcare, service industry, and manufacturing for both new operations and for improving existing operations.

In partnership with PROMODEL Corporation, we're helping schools and community members to develop partnerships that can make local businesses more globally competitive. School teams work with a local business or agency to identify a system that the organization wants to analyze. It may involve solving an operational problem, designing a new facility, or simply looking at the system closely to explore ways to improve. The team compiles data from the partner to construct an animated model of the system and then run "what if" simulations. Statistical reports help the team analyze effect of changes made in the original model.

Teams of teachers, students, and community representatives construct animated models of systems using sophisticated software, conduct simulations of existing conditions and proposed changes, and analyze resulting changes in efficiency and productivity. Students develop skills in communications, research and data collection, probability study, planning, analysis, comparison, and decision-making. Applying this curriculum in business, industrial technology, economics and social studies, teachers and students develop a greater understanding of, and contribute to, their community's economic development.

Teachers integrate the program into existing classes or offer it as a separate class. They involve a team of students who are interested in exploring modeling and simulation, or they might structure a project for the entire class. It might be designed as a semester course or a full-year program...it's up to each school and business partner. Students who become involved may be research possible careers in engineering or business management.

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## How does it work?

A teacher in the school district serves as the leader of a team consisting of two or more students and a representative of a business in the community. The team members participate in an intensive institute in modeling and simulation (two to four days). Using ProModel software, the team begins to build a computerized model using data from the local company or organization...it may be one function or one small section of the organization, or it could be the whole organization, depending on the size and complexity of the business.

As the model is being constructed, the team verifies the data by running simulations and adjusting the information as needed. When the model has been validated by the business partner, the team runs more simulations..."what-if's" with hypothetical changes the partner will consider to achieve greater efficiency, better service, higher productivity...changes like equipment upgrades, facility rearrangements, personnel adjustments, etc. The team will generate reports and analyze the results, comparing between what exists now and the "what-ifs". Students' models can be merged into a bigger model, allowing the team to assign groups to model certain systems and then pull them together into a comprehensive organizational model.

Results of the model analysis can be used to implement change or design new operations, facilities, and procedures for the organization in a highly efficient, effective manner.

## Hardware/Software Requirements

The ProModel software operates in the Windows platform (3.1, Windows '95 and '98). You need access to one or more machines with a minimum configuration of a 486 processor, 16 Mb RAM, 24 Mb hard drive space, a mouse, and a VGA monitor. Choices in the instructional versions of the software include 1) a Professor version, which requires a key plugged into a port, 2) a student version, which allows students to complete small classroom exercises or independent problems on their own machines, and 3) a network version for multiple users.

## Cost (approximate)

| | |
|---|---|
| $ 30 | Student Version Software on CD – limitations on locations, entities, etc. |
| $ 995 | Professor Package – CD, referense/user guides – full version |
| $ 1,995 | Lab Package – Up to 20 simultaneous users, requires a LAN key |
| $ 45 | Additional sets of user manuals |
| $7,500 | Full High School Curriculum Package, includes ServiceModel software, user manuals, 3-day training course for teachers and team, curriculum materials including performance packages, technical support from SSC for one year. |

## What have we done with modeling and simulation?

**Austin Teacher Ginny Riege** and her students partnered with Austin Public Utilities to analyze their billing process. When they completed their project, they had devised a billing cycle system for the utility.

**Glenville-Emmons High School Teacher Ruth Stadheim** has introduced modeling and simulation as an independent study course as well as a unit in her business class. Three of her students will partner with the State Bank of Glenville, and another three students will study the water treatment facility in the small town of Glenville.

**Goodhue Business Teacher Joe Sand** and his students are working with the local farm implement dealer to analyze their inventorying and small parts retail sales. They're also working with the City of Goodhue on a city center development project.

**Pine Island Business Teacher Aaron Jasperson** and his students are modeling several systems with community businesses and the City. Under the leadership of Jasperson and pioneering teacher Karen Doll, who introduced modeling and simulation as a credit class in 1996, the teams have designed and constructed models to...
...improve the efficiency on a conveyer line in a manufacturing plant,
...improve the layout of the municipal liquor store,
...study the possibilities of multiple uses for an historic building on the bike path,
...design an emergency egress route that was approved by the fire marshall and the school board,
...helped the local nursing home to explore ways to make their dining room service more efficient and helpful to residents.

**Olmsted County Central Services** staff worked with Rochester students and Southeast Service Cooperative staff member Tracy Schreiner to model the processes of duplication services and mail sorting. When they completed their model, they presented a set of recommendations to the County Board of Commissioners that could improve efficiency, save staff members time, and potentially reduce costs.

## What do we expect to accomplish with this program?

The possibilities are exciting! Think about it -- businesses reap the benefits of developing improvements and increasing profits with simulation. Students will....

- master a real life application of technology using a real business solution
- contribute to their community's economic development
- develop skills in teamwork, communications, inquiry/research, probability study, organization and planning, analysis, comparison, and business decision making, AND
- discover that learning can be fun and challenging!

We have developed curriculum and are prepared to assist other schools who want to replicate this program in their business, economics, and industrial arts classes. The curriculum addresses four Minnesota Graduation Standards in four learning areas:

Writing and Speaking

Inquiry

Decision Making

Resource Management

## Are you interested

in starting a modeling and simulation program? We will be happy to visit with you and your staff to demonstrate modeling and simulation and discuss how it can be integrated into your curriculum. Would you like to arrange training for your teachers, business partners, and students? Give us a call!

## Who do I contact for more information?

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You may wish to review the accompanying slide presentation for more information about this program.

**Modeling and Simulation in High School:**

**Power-boosting Productivity in a School - Business Program**

Southeast Service Cooperative and area schools, cities, counties and other agencies

1

## Our goals...

- Teachers become facilitators, students take responsibility for learning.
- Students learn with real life problem-solving activities.
- Schools build stronger alliances with the community to enhance learning

2

## What is modeling & simulation?

Mapping a business, constructing it on a computer, and creating "what if" scenarios to learn how we can improve the system.

3

## What is modeling & simulation?

**Using software to...**

- build an animated model of a system to...
- test ideas for increasing efficiency and productivity...
- analyzing the results to make informed decisions...
- before investing $ in change and development.

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## Let's look at a model...

5

## Who teaches simulation?

- Modeling & simulation software developers
- Universities
- Technical colleges

and now.....

- High school teachers and students!

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## What do we accomplish?

- Master a real life application of technology using a real business partner
- Contribute to your community's economic development, while the community aids us in teaching our student body
- Students apply what they're learning in Economics, Business, Math, Science, Industrial Technology

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## What do students accomplish?

Students develop skills in

- teamwork (cooperative learning)
- communications
- inquiry: research, data collection
- probability study
- organization and planning
- analysis, comparison, business decision making

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## How does modeling fit into Economics?

- Students learn to think like their business mentors do.
- Units deal with business community, business structure, capitalism...

What's the effect of proposed changes on gross sales, staffing, production, competition, distribution?

How can we lower costs AND improve quality?

What can we do to increase efficiency and thus increase productivity?

9

## Students learn the benefits of...

Research and applications regarding "what if" analysis -- for instance, analyzing such things as

- staffing
- physical layout of the facility
- employment policies
- operational policies

and the impact of all of this on productivity

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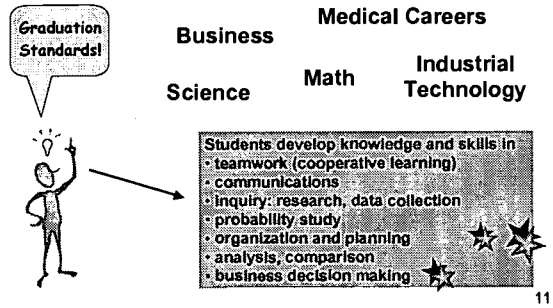
## How does modeling fit into other curriculum?

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## It's a tool to achieve standards

e.g.
Required Minnesota Graduation Standard 9, Resource Management: Economic Systems

**What students should do...**

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## It's a tool to achieve standards

What students should do...

... analyze a public issue in terms of production, distribution and consumption

Minnesota Graduation Standard 9, Resource Management

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## It's a tool to achieve standards

What students should do...

... explain how scarcity of productive resources (e.g. human, capital, technological, natural) impacts decisions concerning the production and distribution of goods and services

Minnesota Graduation Standard 9, Resource Management

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## It's a tool to achieve standards

What students should do...

... analyze how change in the economy affects individuals, households, business, government and the environment

Minnesota Graduation Standard 9, Resource Management

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## It's a tool to achieve standards

**Grad Standard 2: Write and speak**
technical writing

**Grad Standard 4: Math applications**
chance and data analysis

**Grad Standard 5: Inquiry**
conduct research, communicate findings

**Grad Standard 6: Scientific Applications**
environmental systems

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## It's a tool to achieve standards

**Grad Standard 7: People and Cultures**
community interaction

**Grad Standard 8: Decision making**
occupational experience

**Grad Standard 9: Resource Management**
business management

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## The curriculum for modeling/simulation...

...will address Minnesota Graduation Standards...

- resource management
- decision making
- inquiry
- writing and speaking

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## Logistics, obstacles, issues

| | |
|---|---|
| Credit offerings, secondary & post-sec. | Realistic "sizing" of the initial system subject |
| Student schedules, other commitments | Accessing data, equipment |
| Business partner commitment of time | Software/modeling technical support |

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## This is...

**an opportunity for community business, government and the school district to prepare students together!**

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## Potential Partners

- **Manufacturing**
  Aerospace, automotive, electronics, warehousing, consumer products
- **Service Industry**
  Banking, government, insurance, retail, transportation
- **Healthcare Industry**
  Hospitals, medical centers, clinics, nursing services

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## Community partners

Our pioneering community partners....

- Pine Haven Care Center in Pine Island
- Lodemeier Implements in Goodhue
- Olmsted County Central Services

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## Organized Innovation

- State of Minnesota Innovation Grant (BOGIC)
- Five school districts/five government units pioneering the concept!!

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## Our BOGIC Project

- **ROCHESTER** JM School and Olmsted County
- **AUSTIN** Public Schools and Public Utilities
- **GLENVILLE** School and City
- **GOODHUE** School and City
- **PINE ISLAND** School and City

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## The grant supports...

- training
- software
- facilitation
- evaluation and dissemination
- curriculum development

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## The partners give, too...

### The schools

- Technical support with software and lab installations
- A progressive, innovative-minded teacher
- Relaxed rules regarding off-campus learning
- Taking a risk with new curriculum
- Effort to initiate community service projects

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## The partners give, too...

### The government/business partners

- Staff time to work with teacher and students
- Provision of data to use in building models
- Educating teacher and students about issues in business, industry, and government
- Willingness to explore new ideas

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## Our BOGIC Project

**ROCHESTER...**

JM School and Olmsted County studied the central services division -- duplicating, mail sorting, fleet management, shipping and receiving

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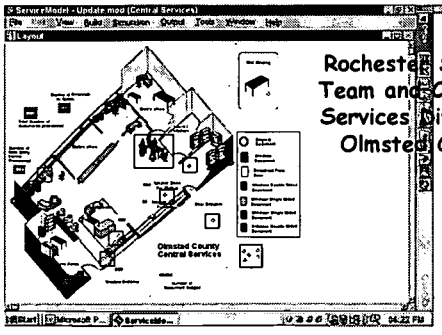
## Olmsted County

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## Olmsted County

**ROCHESTER...**

The team identified areas for improvement -- duplicating and mail sorting -- and came up with numerous recommendations:

Potential savings = **$27,000 +**

Value of consultation = **$40,000**

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## Our BOGIC Project

**AUSTIN...**

High School marketing/business class (9th through 12th grade) assisted the Public Utilities office with analyzing alternative ways to conduct billing processes. They devised a cycle billing model.

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## Our BOGIC Project

**GLENVILLE...**

Business students will help the City identify problems with the water treatment facility and find resolutions to make it operate more efficiently.

32

## Our BOGIC Project

**GOODHUE...**

Business students are helping City officials to market a city center proposal and have constructed a model to demonstrate various uses of a facility.

33

## Our BOGIC Project

**PINE ISLAND...**

High School **Business** and **Industrial Technology** classes have conducted several modeling projects with the city as well as community organizations.

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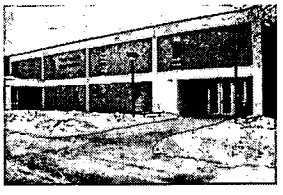
## High School Egress Route



- **Problem:**
  - Currently taking the students too long to exit the building.
- **Purpose:**
  - Meet state "fire code" requirement.

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## High School Egress Route

- **Analysis of Problem**
- **Probable Solutions:**
  - Eliminate crowding on stairways.
  - Even distribution of classes at each exit

Bottleneck on our main stairway.

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## Process

- Scanned school blueprint into the model
- Planned and observed several fire drills
- Compiled information and entered data into computer
- Created model

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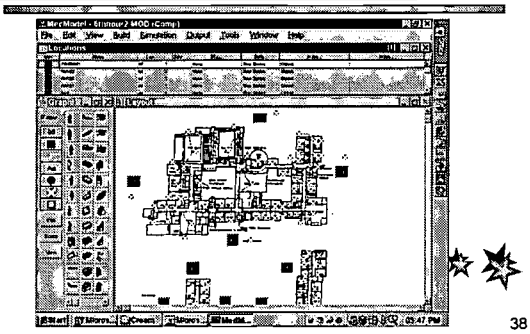
## The Egress Route Model



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## Follow Up

- Met with fire chief and received his approval of the model.
- Presented proposal to school board
- Approved by the school district
- Implemented this fall.

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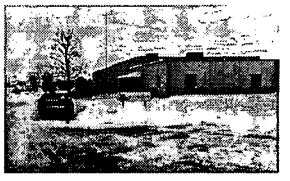
## D.S. Manufacturing



- **Problem:**
  - Inefficient traffic pattern slows manufacturing line
- **Purpose:**
  - To improve the flow of the plating line

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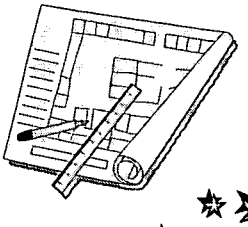
## D.S. Manufacturing

- **Objectives:**
  - Find out if improvements to line are cost effective
  - Cut down on employee travel time and distance



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## Process

- Transferred background from CAD program
- Gained understanding of plating line
- Planned and conducted observations and data collection

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## Process

- Re-created plating line on ProModel
- Created "what-if" models
- Analyzed cost and efficiency of models
- Met with D.S. engineers

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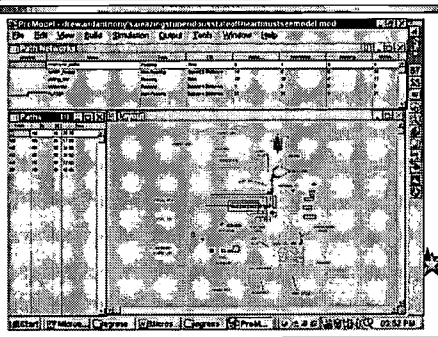
## The Conveyer System Model



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## What's Next?

- Improve efficiency of two robotic workers to implement a 24 hour shift
- Simulate moving and industrial saw and a parts polishing machine

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## City of Pine Island

**The Creamery...**

High School Business Class helped local architects and the City consider multiple uses of an historic creamery building on a bike path...

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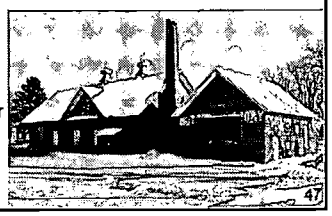
## City of Pine Island

- Plan for "restoration" of historic building
- Possible implementations
  - Coffee shop
  - Youth Center
  - Community Center
  - Restaurant



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## City of Pine Island

**The Creamery...**

Their findings saved the city time and money when they learned that the building wasn't suited for multiple uses.

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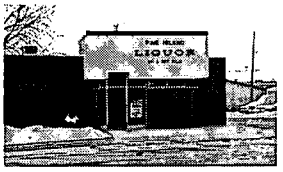
## City of Pine Island

### Municipal Liquor Store



- **Problem:** Location of off-sale
- **Purpose:**
  - Maximize the efficiency of the liquor store's on sale and off sale

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## Municipal Liquor Store

- **Maximize employee usefulness/efficiency**
- **Reduce theft in off sale**
- **Assist with remodeling plan**

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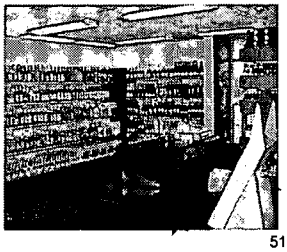
## Process

- **Met with city administrator and store manager**
- **Collected data**
- **Created store layout**
- **Built model**



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## Future Plans

- **Create "what-if" layouts**
- **Meet with city officials**
- **Analyze:**
  - Traffic patterns
  - Off-sale visibility and accessibility

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## Past Projects

- **Pine Haven Care Center**
  - Food Service Management
- **Wobig Pallet Factory**
  - Plan layout of new facility
- **Pine Island High School Cafeteria**
  - Redesigning of food serving lines
    - faster more efficient service

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## Power-Boosting Government with Modeling and Simulation

- **Government Agency Involvement**
  - Animated Graphic Models
  - New Ideas
  - System/Process Changes
  - Education/Communication Tool
    - Community
    - Staff

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## Power-Boosting Government with Modeling and Simulation

- Student Involvement
  - Ambassadors of Projects
  - Gain Lifelong Citizenship skills
  - Develop Win/Win Relationships between school district and Government.

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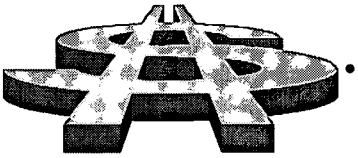
## Power-Boosting Government with Modeling and Simulation



- Fosters Better Understanding
- More Efficient Government

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## Where can YOU go with modeling and simulation?

- The program is replicable.
- PROMODEL is committed to support, visit www.promodel.com
- Start with existing partnerships

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## Where can YOU go with it?

Costs include

- Software
- Training
- Regional facilitation

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## How do we pay for it?

- Seek grant support
- Partners "invest"
- Students sell services to local businesses
- Gifted, School to Work, Tech Prep, Staff Development, Technology Levy

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## Thanks for listening!

### Questions?

**For more info, contact**
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