ERPsim Lab

ERPsim use in OSCM courses

Please Note

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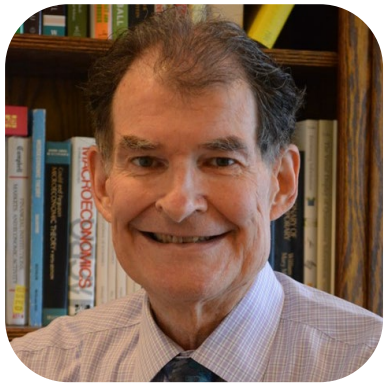
SAP UA NAAC Month of Learning - Workshop
Online | June 19, 2025

ERPsimLab | HEC MONTRÉAL | 20TH ANNIVERSARY
Serious games to learn enterprise systems and business analytics

Agenda



1. **Professor's Experience Sharing**
   - Justin Jagger, Michigan State University
   - Michael J. Murray, University of Huston
2. **Faculty Q&A**
3. **ERPsim Disruptors**
4. **Q&A**

Justin Jagger

Justin Gagger
Fixed-term Faculty
Michigan State University
Broad College of Business
Department: Supply Chain Management

ERPsim Academic Edition

Why I ERPsim

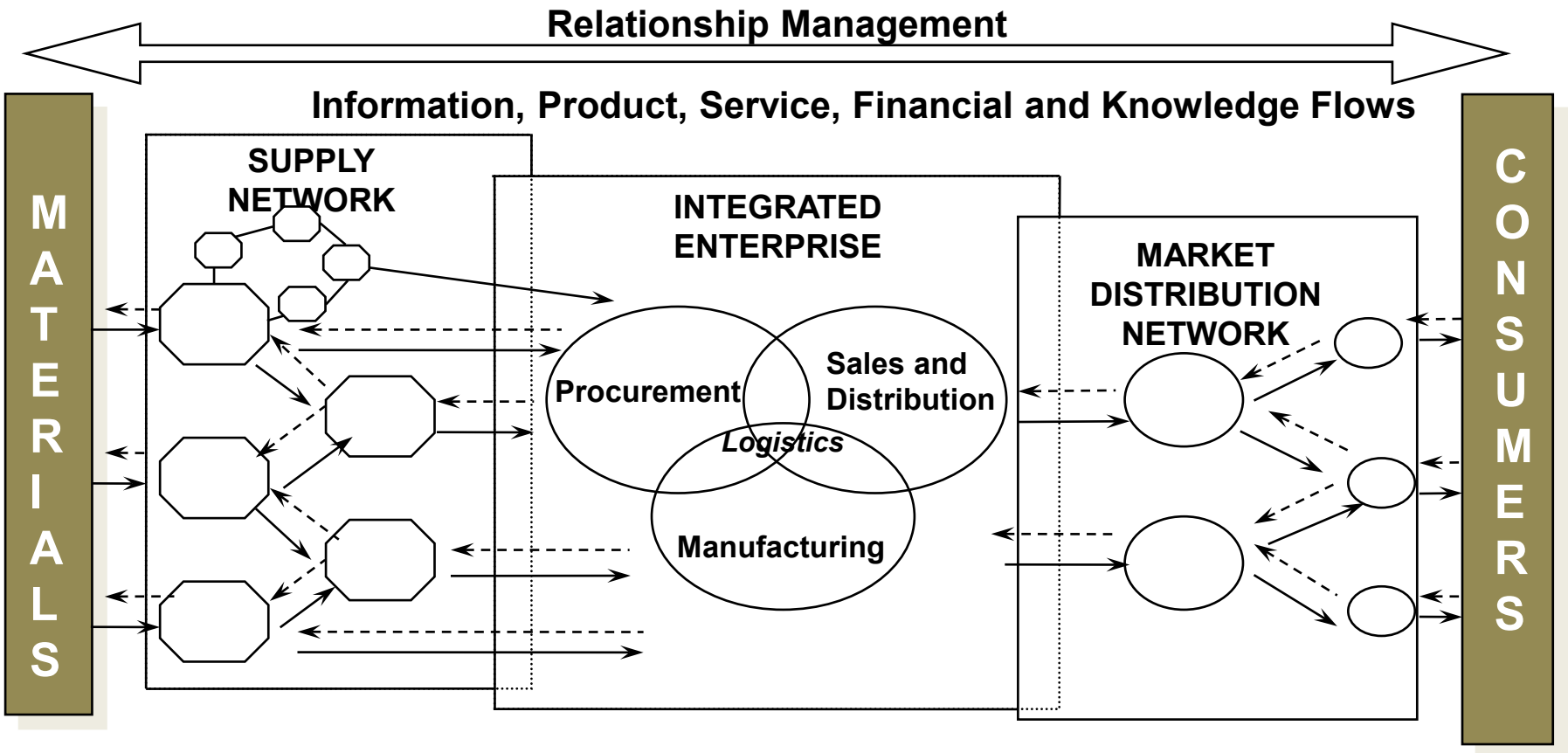
Justin Jagger

Summer 2025

Instructor ("Academic Specialist")

- Education
  - BS, Biology, Central Michigan University
  - MS, Supply Chain Management, Michigan State University
- Prior industry experience in the biologics/vaccine industry
- Joined Broad College of Business '07
- Taught first SAP SCM focused elective ~2017
- Previously attempted to "inject" SAP/ERPsim into existing courses

The Integrated Enterprise

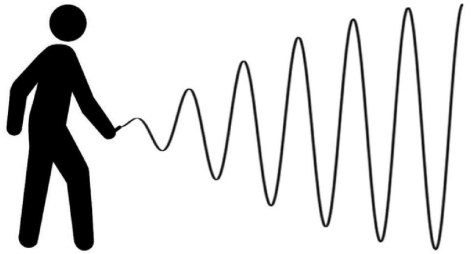


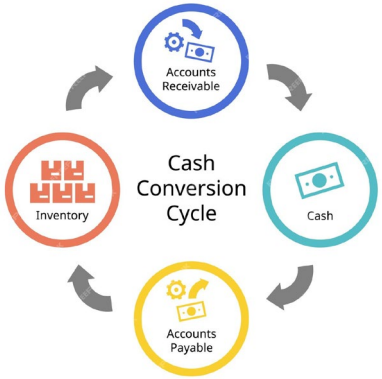
END TO END SUPPLY CHAIN VIEW: Capacity, Information, Core Competencies, Capital and Human Resources

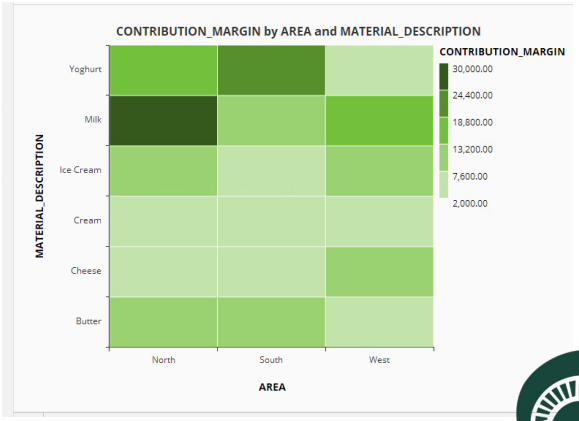
Bowersox et al, 2004

Why Critical Thinking Matters in SCM

- Bullwhip Effect
  - The first simulation
- Business Processing and Integration principles
  - MRP
  - Cash to Cash
- Communication across disciplines
  - Reports and analytics (“dashboarding”)







Blooms Taxonomy

Knowledge

Comprehension

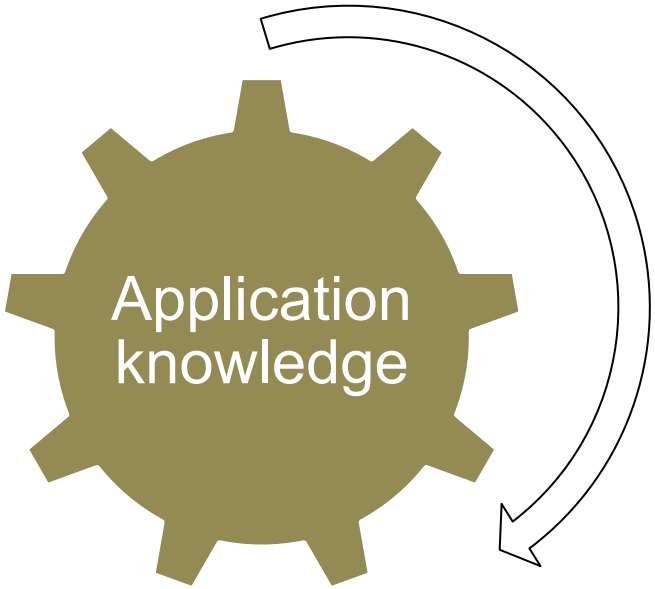
Application

Analysis

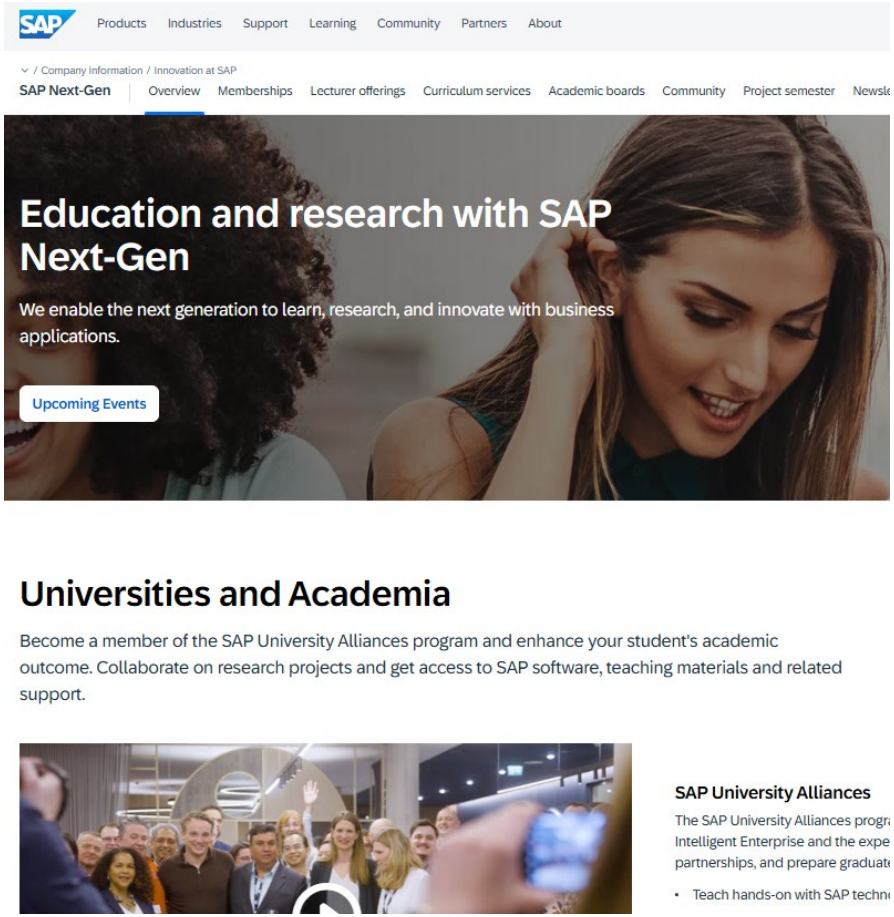
Synthesis

Evaluation

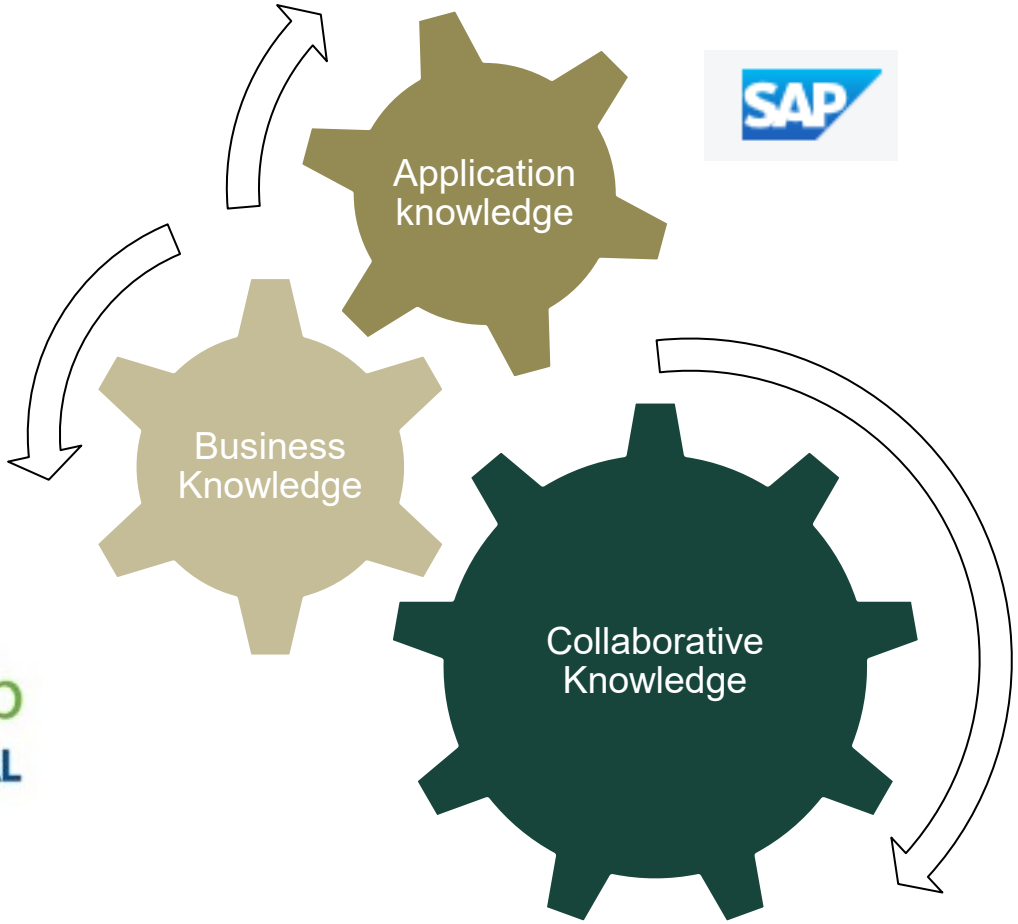
Competency Approach



Kang and Santhanam, 2004



Competency Approach



ERPsimLab
HEC MONTRÉAL

Leger, et al, 2009

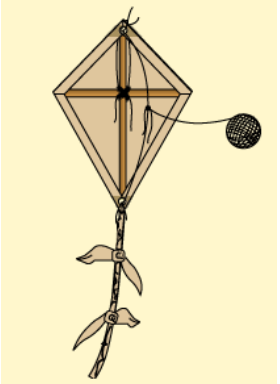
ERPsimLab
HEC MONTRÉAL

Ability to

- Create a shared/communal experience of learning
  - Mentally rewarding
  - Team dynamics and other “human factors”
- Introduce Integrated SCM
  - Business Functions
  - Causal relationships
- Gateway for topical “Deep Dive”
  - Sustainability
  - Digital Supply Chain
    - Data Visualization
    - Machine Learning/AI

SCM 463: ERP SCM APPLICATIONS

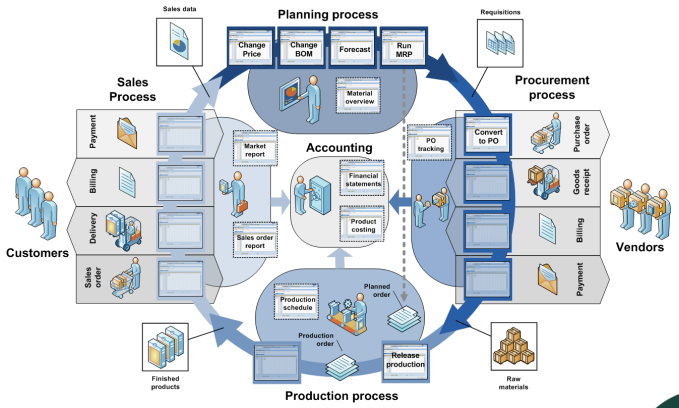
- 2credit elective
- 70-90 students per semester
- Intro course focused on core ERP concepts.
  - Flyakite Integrated Case Study
  - ERPsim Maple/MFG intro-> extended



ERP Muesli

MBA ERPsim Exposure

- **SCM 826 Manufacturing Design and Analysis**
  - MFG INTRO
  - Introduction to Data Aggregation and Visualization
- **SCM 853 Operations Management**
  - MFG EXT
    - Multiple visualization tools
    - Actively researching data aggregation via AI to allow for key deeper SCM analysis (fill rates/ stockouts; cash to cash)

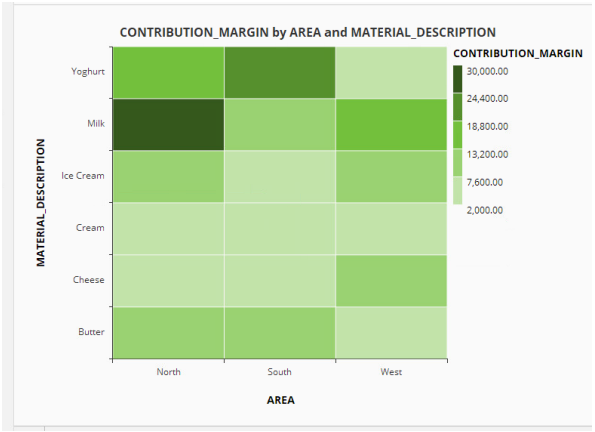


Business Knowledge; SCM Context

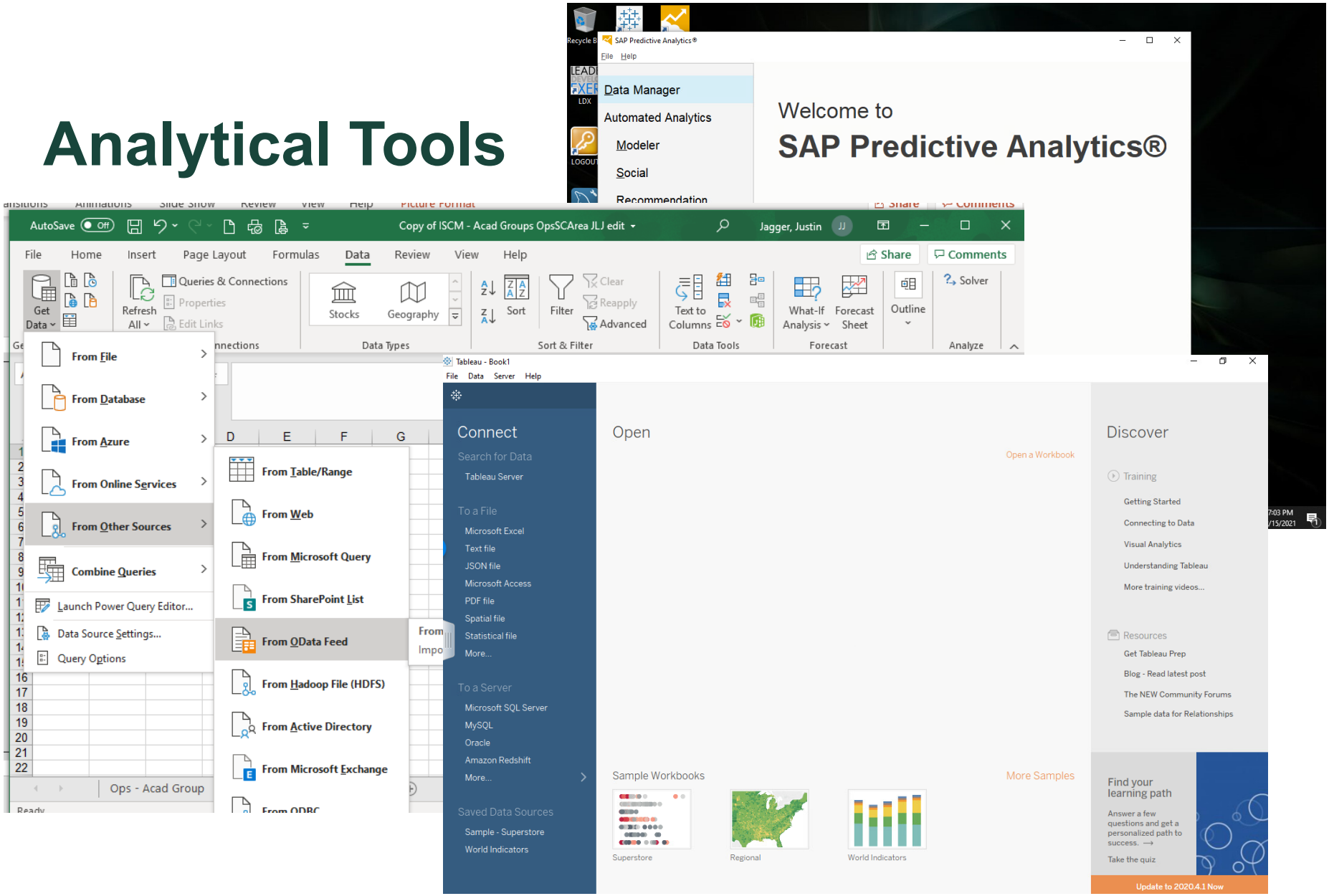
- **Decision activities** including purchasing and production and sales and distribution (e.g. pricing) with impacts to performance
- **Analytical opportunities** including cost per unit versus revenue within a simulated market space; competitive aspects that elicit analysis
- **Application exploration** track performance and build visualizations and other dashboarding; can focus on technical expertise
- **Team based learning** activity; communal experience
  - Trust
  - Visibility
  - Equitable

Executive Learning/Masters Level

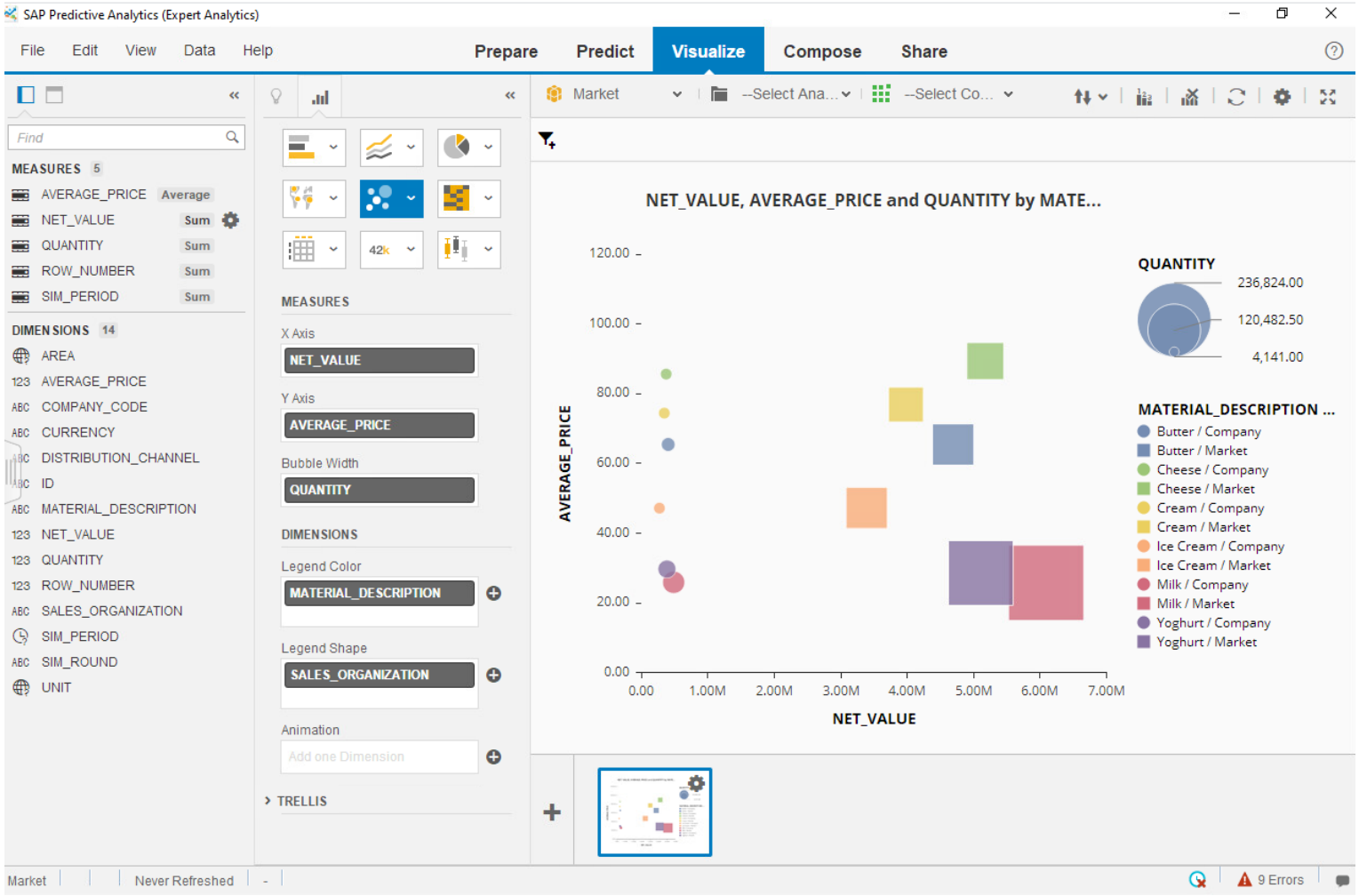
- LOGISTICS Intro/EXT/Platinum
- Limited time exposure
- Not directly competing for market share
- Rapid exposure to analytical tools



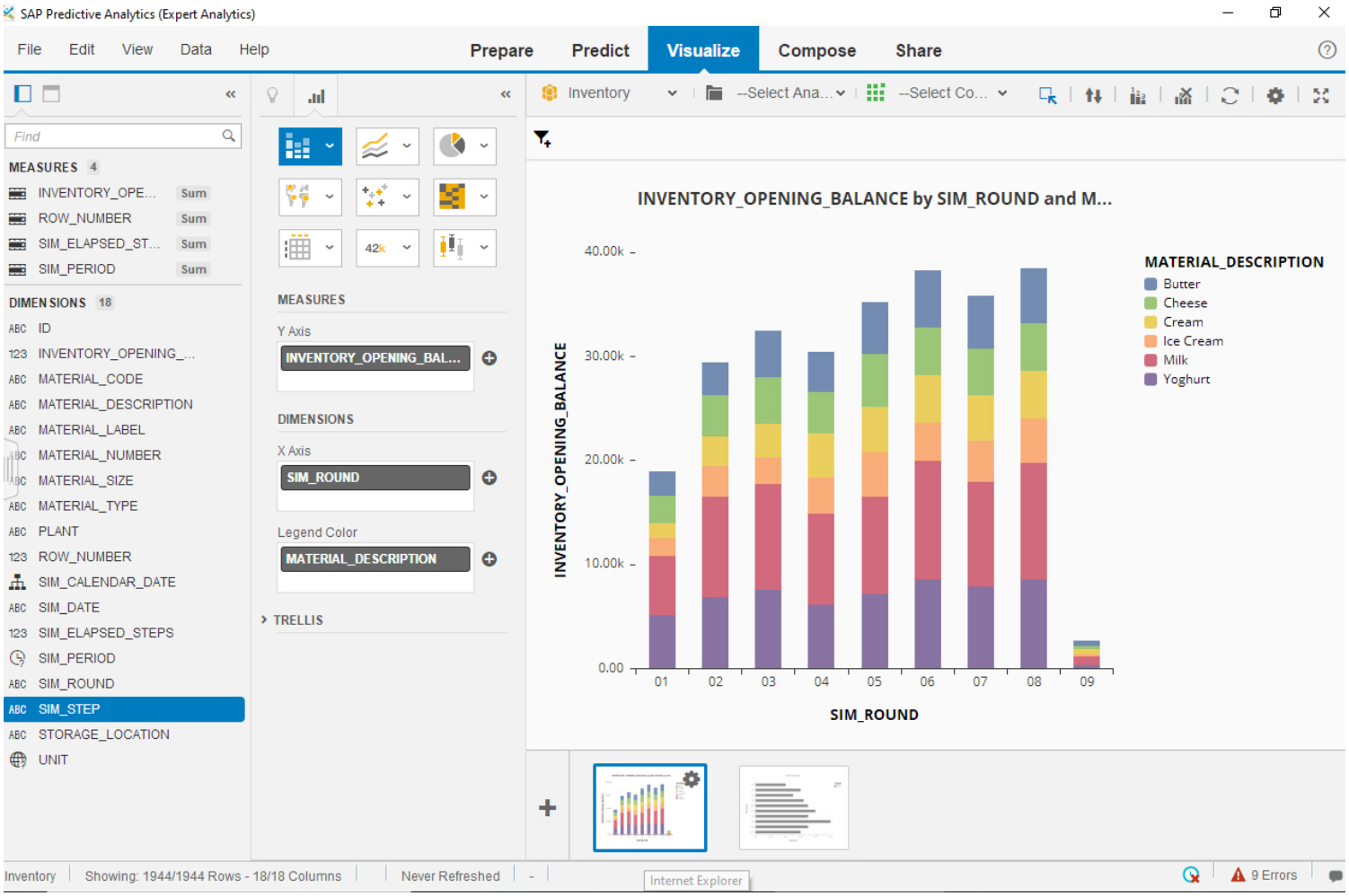
Analytical Tools



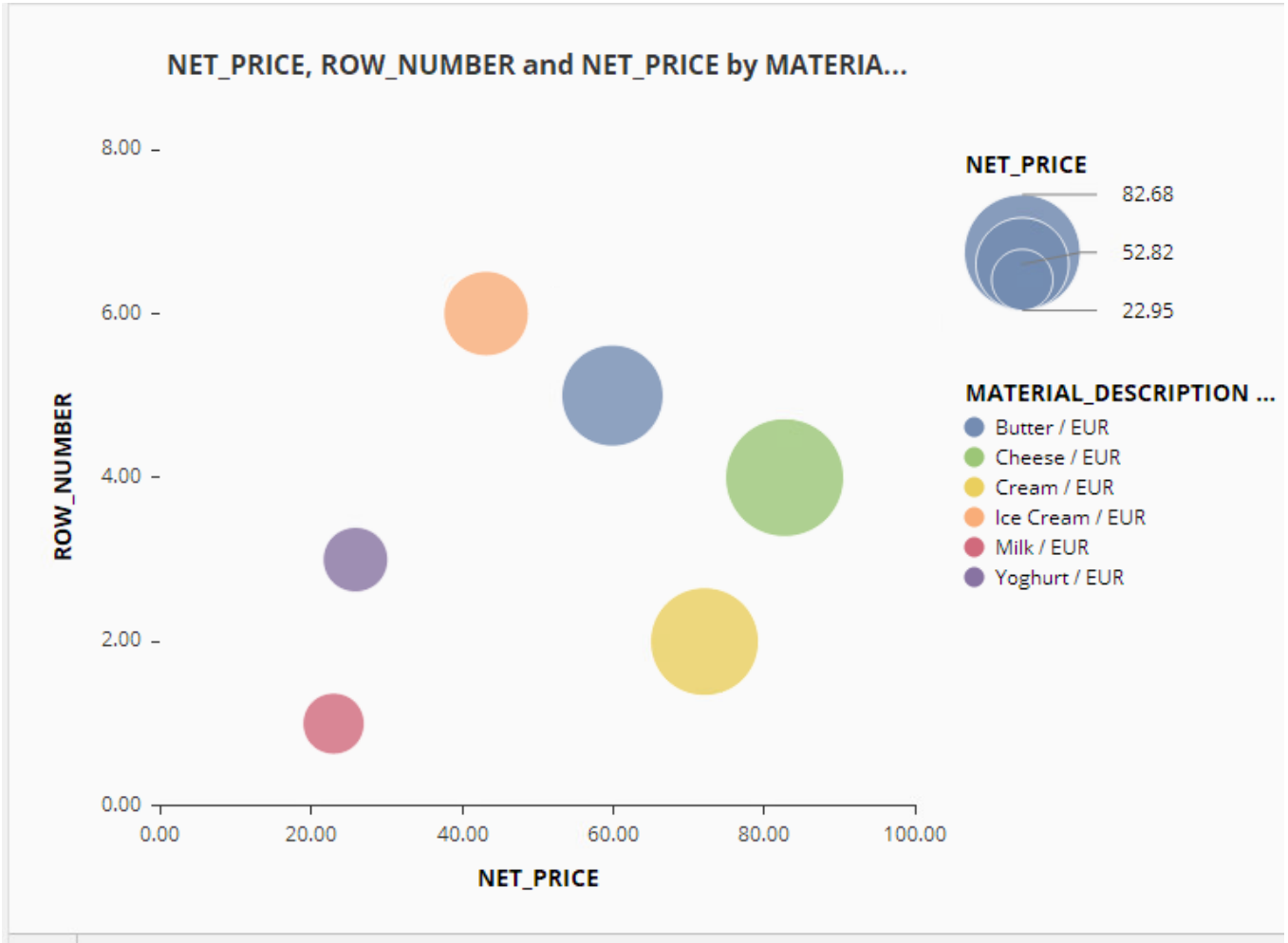
MARKET DATA: Multi-dimensional plots



What was the inventory balance by material and round?

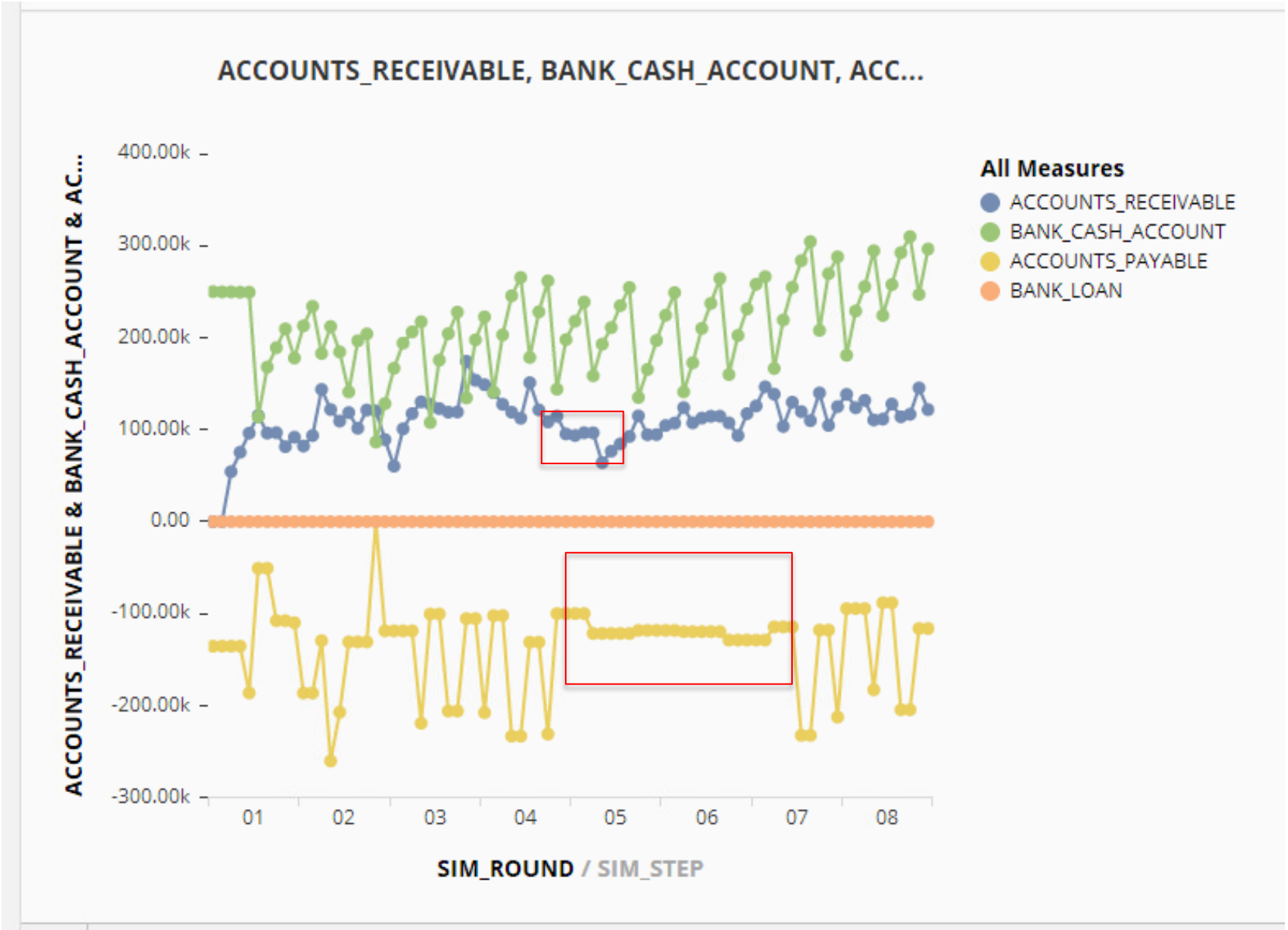


What was highest priced item?



Looking ahead

- Adoption of AI capabilities to provide technical assistance in formatting data for creation of metrics
- Advanced cloud-based visualization techniques with ability to slice/dice.


ACCOUNTS_RECEIVABLE, BANK_CASH_ACCOUNT, ACC...
ACCOUNTS_RECEIVABLE & BANK_CASH_ACCOUNT & AC...
400.00k
300.00k
200.00k
100.00k
0.00
-100.00k
-200.00k
-300.00k
01
02
03
04
05
06
07
08
SIM_ROUND / SIM_STEP
All Measures
ACCOUNTS_RECEIVABLE
BANK_CASH_ACCOUNT
ACCOUNTS_PAYABLE
BANK_LOAN

Course and Syllabus Assessment

- AI prompts
- Entered syllabi for both 826 and 853

Manufacturing Design and Analysis (826)

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4. Overall Educational Value

The course transforms theoretical instruction into **actionable learning** through a hands-on and iterative approach. Students finish the course equipped to:

- Assess and enhance manufacturing systems using simulation data.
- Operate within integrated enterprise systems.
- Apply analytical tools for process optimization.
- Communicate performance insights effectively in professional settings.

These skills are directly transferable to careers in operations, supply chain management, and industrial analytics.

Operations Strategy (853)

Based on the syllabus for **SS25-SCM 853: Manufacturing Decision and Analysis**, here is a comprehensive review of how the **projects and assignments** contribute to student learning in **Operations Strategy**, along with suggestions for possible improvement.

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1. Educational Value of Projects and Assignments

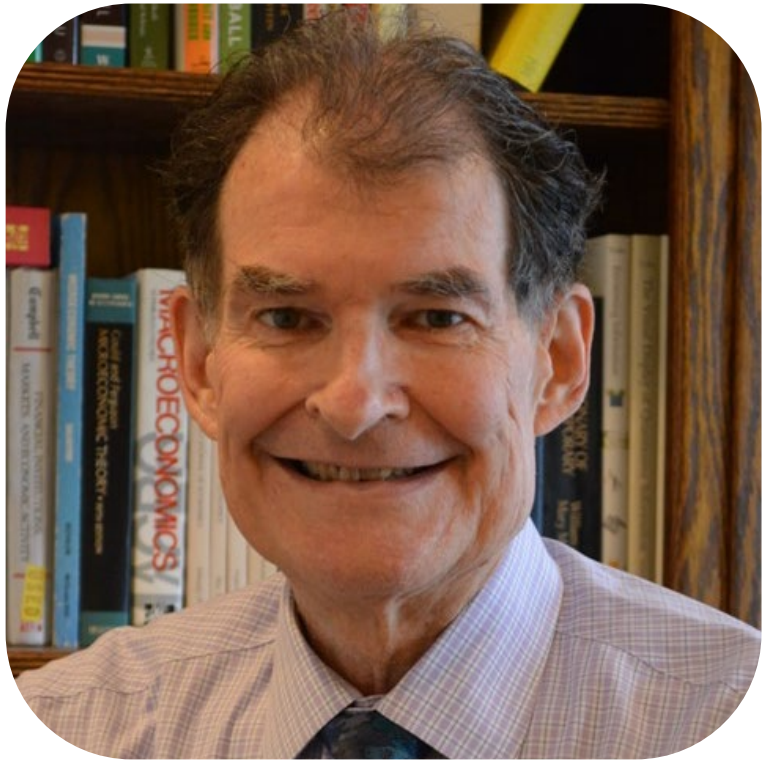
a. ERPsim Activities (Participation and Final Game)

- **Description:** Students engage in ERPsim Logistics and Digital Transformation Games, simulating real-time decision-making across the supply chain.
- **Learning Outcome:** This hands-on simulation ties directly to operations strategy principles like MRP, push/pull systems, and KPI-driven decisions. It enhances systems thinking, collaboration, and strategic resource allocation.

SPARTANS WILL.

thankyou

Michael J. Murray



Michael J. Murray
Instructional Assistant Professor
University of Houston
C. T. Bauer College of Business
Department: Decision and Information Sciences

ERPsim Academic Edition

Teaching Supply Chain Management with SAP and ERPsim

Michael J. Murray, PhD, PE
Instructional Associate Professor
Univ. of Houston/C.T. Bauer College of Business

We offer ERP courses in both the undergraduate and graduate curriculum

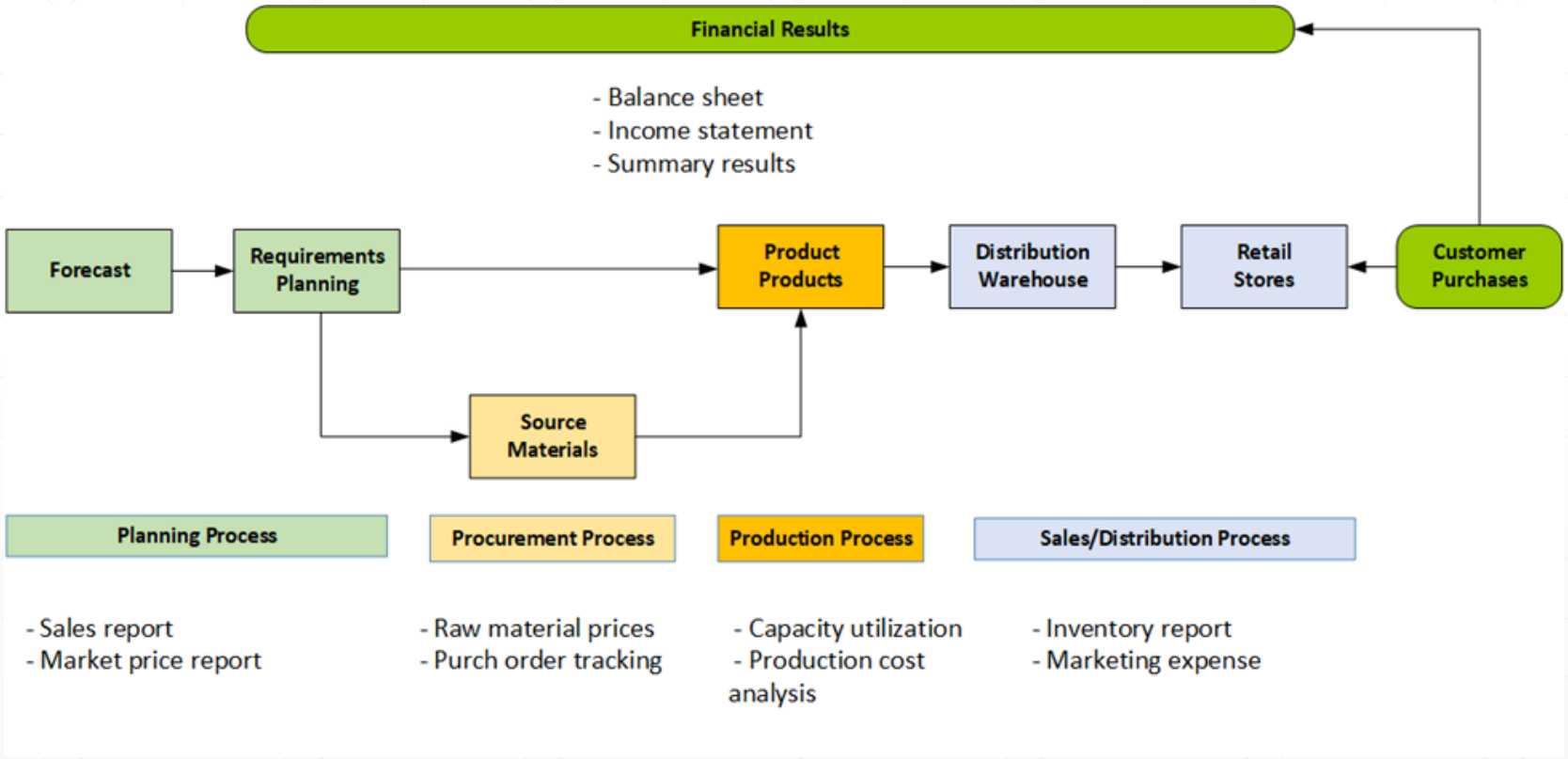
- Required for MS SCM and elective for MBA's; elective for undergrads
- ERPsim Muesli Manufacturing simulation has been included since 2008
- This presentation will focus on graduate course, but can apply to undergrad

The course has three primary learning goals

- Show how ERP systems are used to execute the core supply chain business processes (based on SCOR* model)
- Introduce supply chain finance and focus on how it drives supply chain decisions
- Use data/ analytics to improve supply chain performance

* *ASCM SCOR Model*. (n.d.). Retrieved January 16, 2022, from https://scor.ascm.org/processes/introduction

ERPsim and the SCOR model

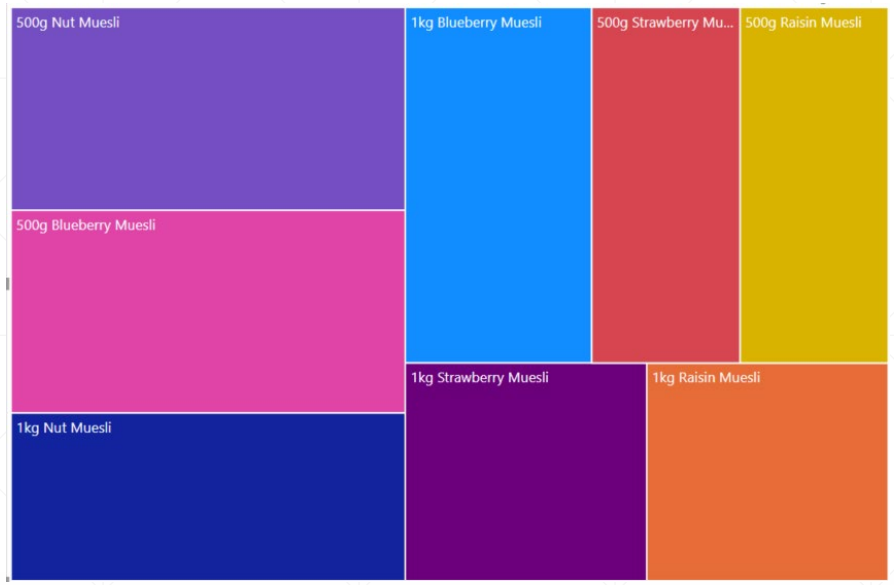


Students use a variety of tools

- Open-source finance textbook: Two chapters from *Principles of Finance*, Dahlquist & Knight, 2024. Rice University OpenStax (free).
- SAC exercises* and PowerBI (Business Builders starting fall, 2025)
- Muesli manufacturing simulation: Introduction > Extended > Advanced
- Manufacturing Cash-to-Cash exercise
- Balanced scorecard
- Readings paired with case studies

* Kalé, Nitin and Jones, Nancy. *Practical Analytics, 2nd Ed*, 2020.

Example analytics



Production and Inventory metrics				Actual	
KPI	Target	Q1	Q2	Q3	Q4
Capacity utilization	75%	66.7%	71.4%	82.9%	77.8%
Total setup time	min	96 hr.	90 hr.	77 hr.	82 hr.
Average fixed cost	1.69	1.90	1.78	1.53	1.63
Inventory turns	3.0	2.0	2.7	3.4	3.1
% Stockouts	min	NM	7	3	2
Days Sales Outstanding (DSO)	< 15	18.6	20.2	17.3	13.5
Days of Inventory (DOI)	< 7	7.3	6.4	8.1	9.6
Days Payable Outstanding (DPO)	> 10	0	11.7	10.3	9.1

	A	B	C
1	**Statement of Cash Flows for Simulation**		
2			
3	**Cash flows from operating activities:**		
4	Net income (loss)		2,274,396.12
5	Adjustments to reconcile net income (loss) to net cash provided by operating activities		
6	Depreciation and amortization		
7	Building	318,181.92	
8	Equipment	272,727.60	
9	Changes in working capital		
10	Accounts receivable	(1,783,259.50)	
11	Finished inventories	(297,181.40)	
12	Raw material inventories	(6,567.42)	
13	Accounts payable	310,244.31	
14	Net cash provided by operating activities		1,088,541.63
15			
16	**Cash flows from investing activities:**		
17	Expenditures for property, plant and equipment	-	
18	Net cash provided by (used in) investing activities		-
19			
20	**Cash flows from financing activities:**		
21	Repayment of debt		
22	Dividends paid		
23	New debt issued (bank loans)	329,111.89	
24	Net cash provided by (used in) financing activities		329,111.89
25			
26	**Increase (decrease) in cash and cash equivalents**		1,417,653.52
27	Cash and cash equivalents at beginning of simulation		3,000,000.00
28	Cash and cash equivalents at end of simulation		4,417,653.52

Partial list of course readings and case studies

- Souza, G.C. (2014). Supply chain analytics. *Business Horizons*, 57, 595 – 605.
- Ransbotham, S., Kiron, D., & Prentice, P.K. (2015). Minding the Analytics Gap. *MIT Sloan Management Review, 56 (3), 63 – 68*.
- Davenport, T.H. (2013). Keep up with your quants. *Harvard Business Review, 91 (7/8), 120 – 123*.
- Kaplan, R.S., & Norton, D.P. (2007). Using the balanced scorecard as a strategic management system. *Harvard Business Review, 85 (7/8), 150 – 161*.
- Business Intelligence at SYSCO (HBS 9-604-080)
- Caterpillar Tunneling: Revitalizing User Adoption of Business Intelligence (Ivey W13513)
- Managing with Analytics at P&G (HBS 9-613-045)
- The Scotts Company A & B (Insead INS915 & IN918)

How are students assessed?

- Standards-based grading approach
- Individual formative quizzes and summative mid-term assessment
- Team-based case study presentation
- Team-based “Annual Report” with balanced scorecard based on advanced manufacturing simulation

Do students learn durable skills?

- ✓ Demonstrate the execution of SCOR processes with ERP
- ✓ Less enthusiasm about SAP's ease of use
- ✓ Develop an understanding and appreciation of the integration of finance with SCM

	Start of Course		End of Course			
	Mean	SD	Mean	SD	t-statistic	p-value
1. Ability to accomplish supply chain transactions in SAP	2.54	1.77	5.54	1.07	8.25	0.000
2. Attitude about SAP's ease of use	4.23	1.53	4.92	1.38	1.63	0.116
3. Overall attitude towards SAP	4.50	1.73	5.69	1.09	2.98	0.006
4. Knowledge of financial terminology	4.19	1.50	5.38	1.17	2.87	0.008
5. Knowledge of financial processes	3.88	1.28	5.23	1.18	3.47	0.002

Reference: Murray, Michael J. (2022) "Teaching how supply chain operations impact financial results: A case study using cloud-based simulation, " *Southwestern Business Administration Journal*: Vol. 20: Iss. 1, Article 2. Available at: https://digitalscholarship.tsu.edu/sbaj/vol20/iss1/2

Do students learn durable skills (continued)?

- ✓ Show how supply chain financial decisions affect overall performance
- ✓ Use data/analytics to improve supply chain performance

	Start of Course		End of Course			
	Mean	SD	Mean	SD	t-statistic	p-value
6. Knowledge of supply chain process financial impact	5.08	1.02	5.88	0.82	3.10	0.005
7. Knowledge of analytics terminology	4.50	1.27	5.65	1.20	2.98	0.006
8. Knowledge of analytics processes	4.50	1.33	5.58	1.14	2.62	0.015
9. Ability to interpret analytic results	4.69	1.44	5.88	0.99	3.44	0.002
10. Attitude towards supply chain analytics	5.81	1.44	6.50	0.71	1.93	0.065

Reference: Murray, Michael J. (2022) "Teaching how supply chain operations impact financial results: A case study using cloud-based simulation, " *Southwestern Business Administration Journal*: Vol. 20: Iss. 1, Article 2. Available at: https://digitalscholarship.tsu.edu/sbaj/vol20/iss1/2

Opportunities for improvement

- Incorporate more predictive analytics
- Apply machine learning where appropriate
- Consider generative AI applications?

Souza's Supply Chain Analytics

Table 1. SCOR model and examples of decisions at the three levels

SCOR Domain	Source	Make	Deliver	Return
Activities	Order and receive materials and products	Schedule and manufacture, repair, remanufacture, or recycle materials and products	Receive, schedule, pick, pack, and ship orders	Request, approve, and determine disposal of products and assets
Strategic (time frame: years)	• Strategic sourcing • Supply chain mapping	• Location of plants • Product line mix at plants	• Location of distribution centers • Fleet planning	• Location of return centers
Tactical (time frame: months)	• Tactical sourcing • Supply chain contracts	• Product line rationalization • Sales and operations planning	• Transportation and distribution planning • Inventory policies at locations	• Reverse distribution plan
Operational (time frame: days)	• Materials requirement planning and inventory replenishment orders	• Workforce scheduling • Manufacturing, order tracking, and scheduling	• Vehicle routing (for deliveries)	• Vehicle routing (for returns collection)
Plan	Demand forecasting (long term, mid term, and short term)			

Souza's Supply Chain Analytics

Table 2. Analytic techniques used in supply chain management

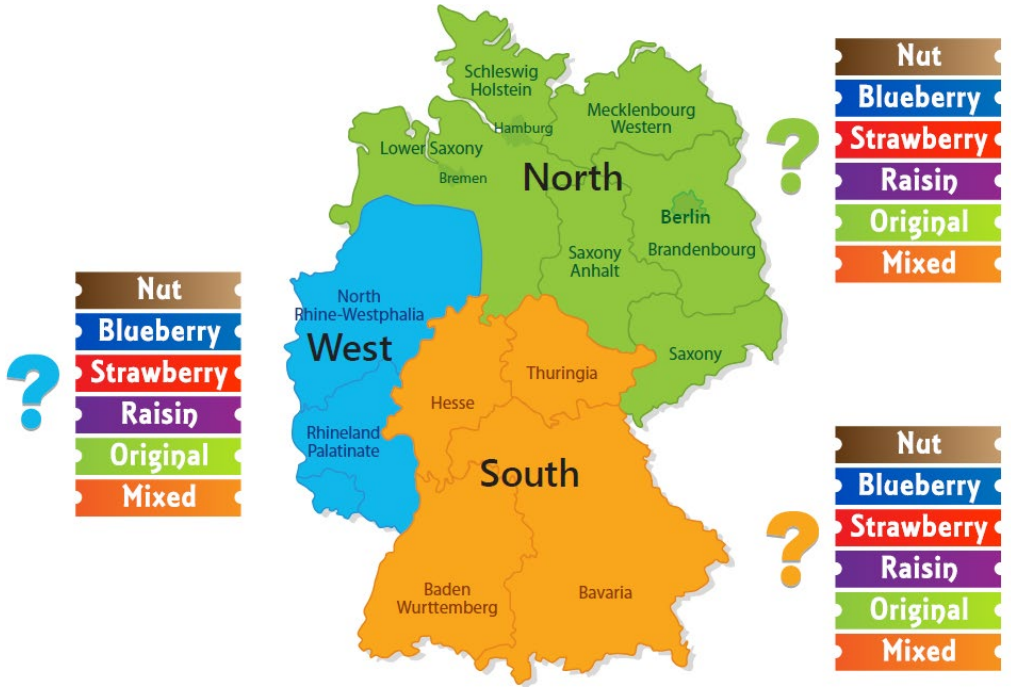
Analytics Techniques	Source	Make	Deliver	Return
Descriptive	• Supply chain mapping	• Supply chain visualization		
Predictive	• Time series methods (e.g., moving average, exponential smoothing, autoregressive models) • Linear, non-linear, and logistic regression • Data-mining techniques (e.g., cluster analysis, market basket analysis)			
Prescriptive	• Analytic hierarchy process • Game theory (e.g., auction design, contract design)	• Mixed-integer linear programming (MILP) • Non-linear programming	• Network flow algorithms • MILP • Stochastic dynamic programming	

Q&A
Experience Sharing

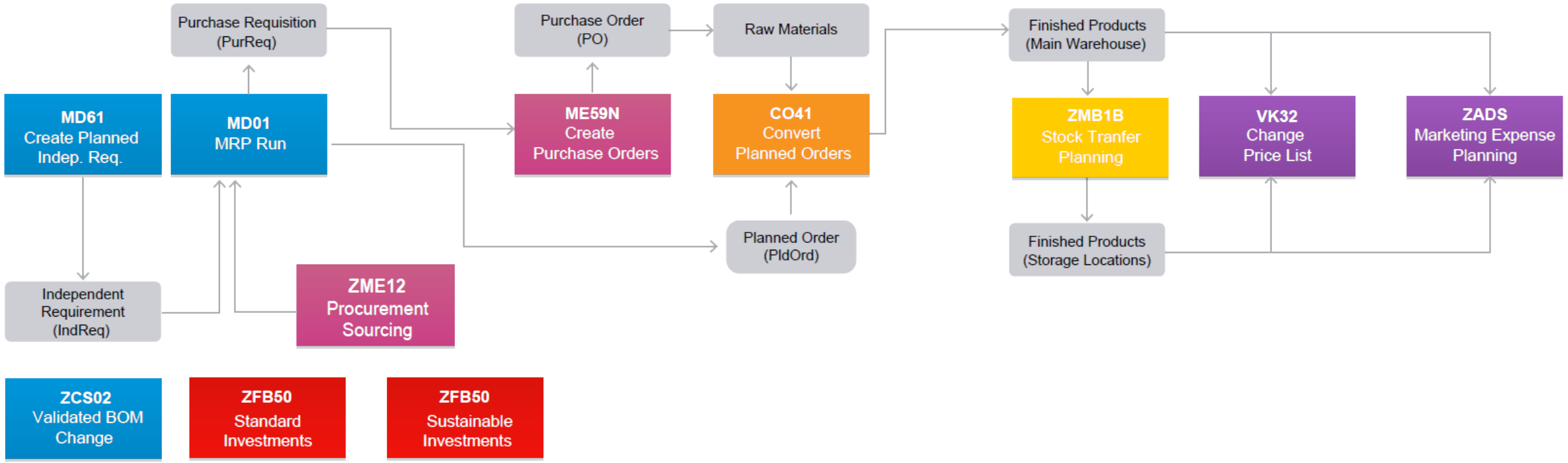
ERPsim Disruptors

ERPsim Academic Edition

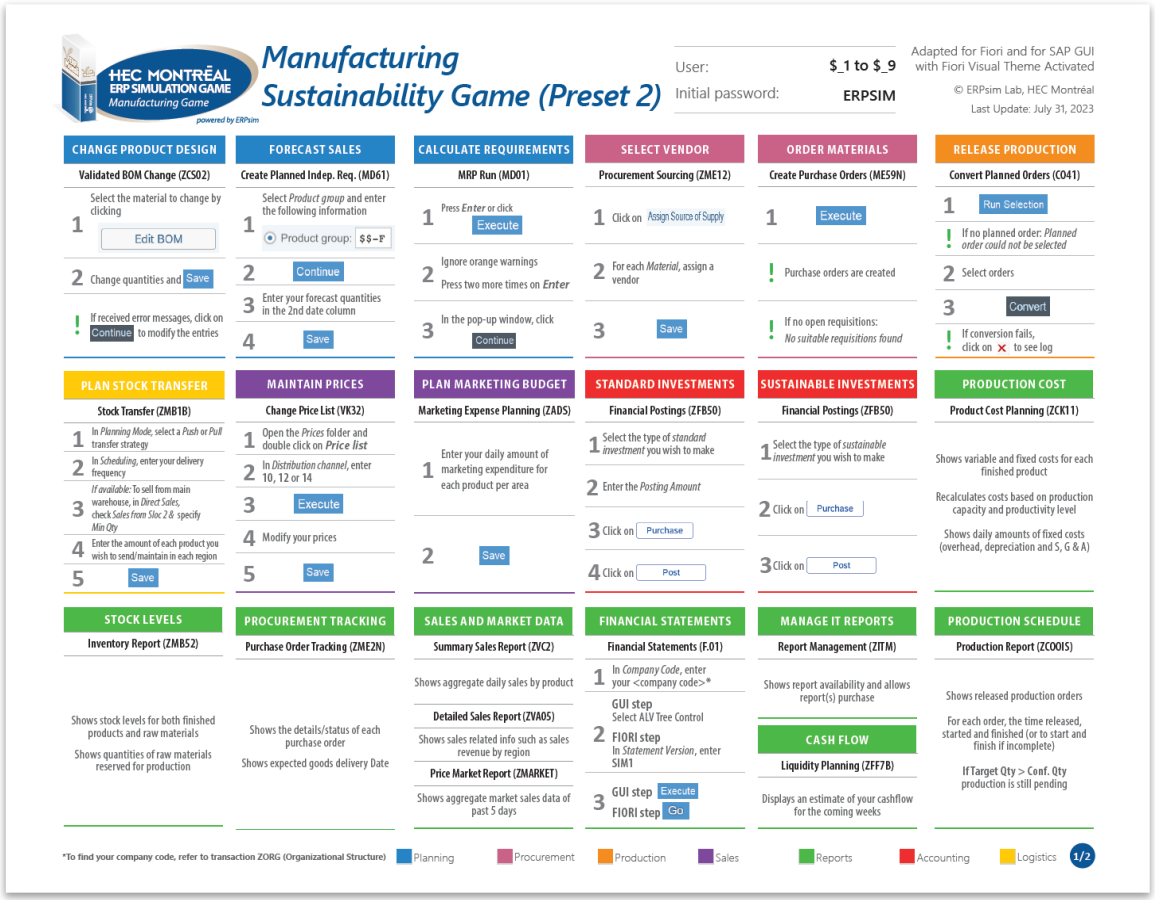
ERPsim Manufacturing



Manufacturing Sustainability Game Layout



Job Aid (Manufacturing Sustainability Preset 2/3)



HEC MONTRÉAL ERP SIMULATION GAME Manufacturing Game powered by ERPsim

Manufacturing Sustainability Game (Preset 2)

User: $_1 to $_9
Initial password: ERPSIM

Adapted for Fiori and for SAP GUI with Fiori Visual Theme Activated

Last Update: July 31, 2023

CHANGE PRODUCT DESIGN
Validated BOM Change (ZCS02)
1. Select the material to change by clicking → Edit BOM
2. Change quantities and Save
! If received error messages, click on Continue to modify the entries

FORECAST SALES
Create Planned Indep. Req. (MD61)
1. Select *Product group* and enter the following information → Product group: $$-F
2. Continue
3. Enter your forecast quantities in the 2nd date column
4. Save

CALCULATE REQUIREMENTS
MRP Run (MD01)
1. Press *Enter* or click Execute
2. Ignore orange warnings. Press two more times on *Enter*
3. In the pop-up window, click Continue

SELECT VENDOR
Procurement Sourcing (ZME12)
1. Click on Assign Source of Supply
2. For each *Material*, assign a vendor
3. Save

ORDER MATERIALS
Create Purchase Orders (ME59N)
1. Execute
! Purchase orders are created
! If no open requisitions: *No suitable requisitions found*

RELEASE PRODUCTION
Convert Planned Orders (CO41)
1. Run Selection
! If no planned order: *Planned order could not be selected*
2. Select orders
3. Convert
! If conversion fails, click on ✕ to see log

PLAN STOCK TRANSFER
Stock Transfer (ZMB1B)
1. In *Planning Mode*, select a *Push* or *Pull* transfer strategy
2. In *Scheduling*, enter your delivery frequency
3. *If available:* To sell from main warehouse, in *Direct Sales*, check *Sales from Sloc 2* & specify *Min Qty*
4. Enter the amount of each product you wish to send/maintain in each region
5. Save

MAINTAIN PRICES
Change Price List (VK32)
1. Open the *Prices* folder and double click on ***Price list***
2. In *Distribution channel*, enter 10, 12 or 14
3. Execute
4. Modify your prices
5. Save

PLAN MARKETING BUDGET
Marketing Expense Planning (ZADS)
1. Enter your daily amount of marketing expenditure for each product per area
2. Save

STANDARD INVESTMENTS
Financial Postings (ZFB50)
1. Select the type of *standard investment* you wish to make
2. Enter the *Posting Amount*
3. Click on Purchase
4. Click on Post

SUSTAINABLE INVESTMENTS
Financial Postings (ZFB50)
1. Select the type of *sustainable investment* you wish to make
2. Click on Purchase
3. Click on Post

PRODUCTION COST
Product Cost Planning (ZCK11)
Shows variable and fixed costs for each finished product
Recalculates costs based on production capacity and productivity level
Shows daily amounts of fixed costs (overhead, depreciation and S, G & A)

STOCK LEVELS
Inventory Report (ZMB52)
Shows stock levels for both finished products and raw materials
Shows quantities of raw materials reserved for production

PROCUREMENT TRACKING
Purchase Order Tracking (ZME2N)
Shows the details/status of each purchase order
Shows expected goods delivery Date

SALES AND MARKET DATA
Summary Sales Report (ZVC2)
Shows aggregate daily sales by product
Detailed Sales Report (ZVA05)
Shows sales related info such as sales revenue by region
Price Market Report (ZMARKET)
Shows aggregate market sales data of past 5 days

FINANCIAL STATEMENTS
Financial Statements (F.01)
1. In *Company Code*, enter your <company code>*
2. GUI step: Select ALV Tree Control
   FIORI step: In *Statement Version*, enter SIM1
3. GUI step: Execute
   FIORI step: Go

MANAGE IT REPORTS
Report Management (ZITM)
Shows report availability and allows report(s) purchase

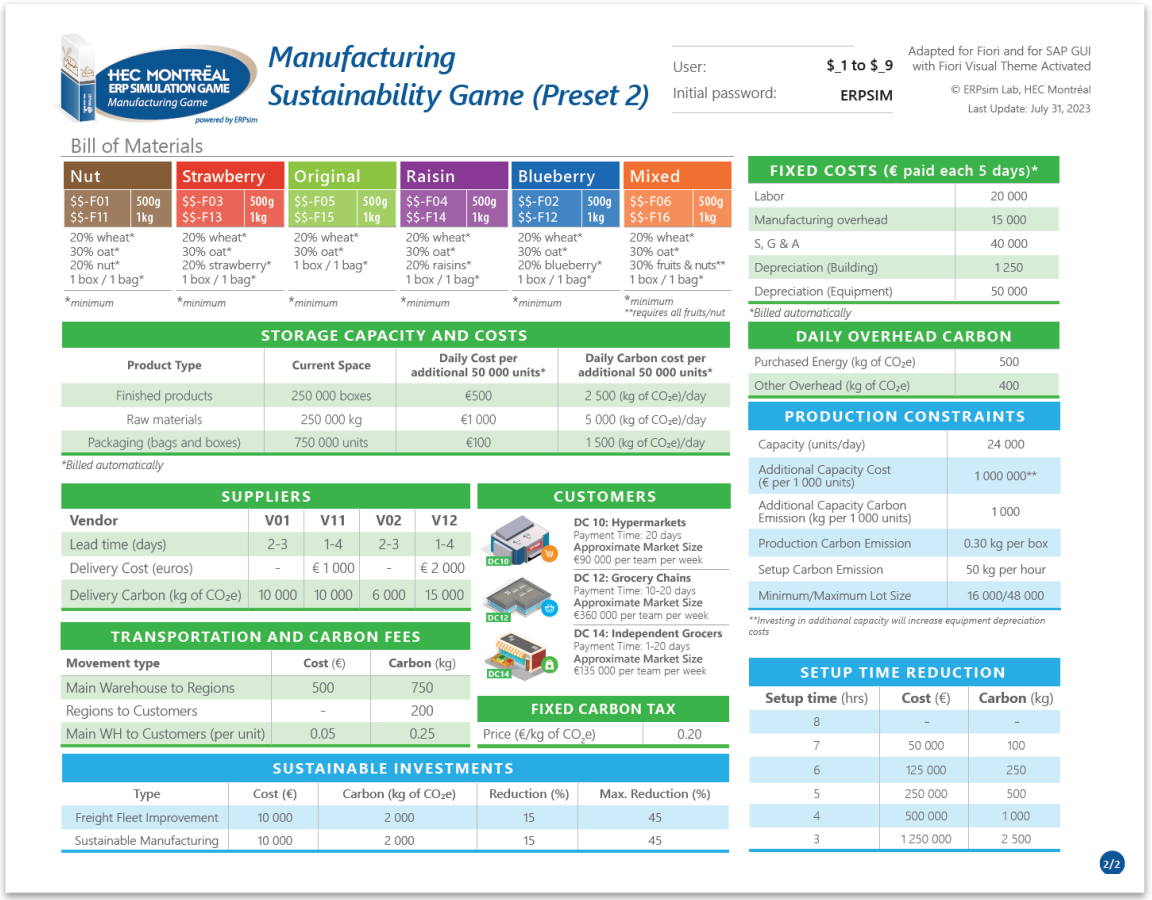
CASH FLOW
Liquidity Planning (ZFF7B)
Displays an estimate of your cashflow for the coming weeks

PRODUCTION SCHEDULE
Production Report (ZCOOIS)
Shows released production orders
For each order, the time released, started and finished (or to start and finish if incomplete)
If Target Qty > Conf. Qty production is still pending

*To find your company code, refer to transaction ZORG (Organizational Structure)

Planning | Procurement | Production | Sales | Reports | Accounting | Logistics

1/2



HEC MONTRÉAL ERP SIMULATION GAME Manufacturing Game powered by ERPsim

Manufacturing Sustainability Game (Preset 2)

User: $_1 to $_9
Initial password: ERPSIM

Adapted for Fiori and for SAP GUI with Fiori Visual Theme Activated

Last Update: July 31, 2023

Bill of Materials

Nut	Strawberry	Original	Raisin	Blueberry	Mixed
$$-F01 / $$-F11 (500g / 1kg)	$$-F03 / $$-F13 (500g / 1kg)	$$-F05 / $$-F15 (500g / 1kg)	$$-F04 / $$-F14 (500g / 1kg)	$$-F02 / $$-F12 (500g / 1kg)	$$-F06 / $$-F16 (500g / 1kg)
20% wheat* 30% oat* 20% nut* 1 box / 1 bag*	20% wheat* 30% oat* 20% strawberry* 1 box / 1 bag*	20% wheat* 30% oat* 1 box / 1 bag*	20% wheat* 30% oat* 20% raisins* 1 box / 1 bag*	20% wheat* 30% oat* 20% blueberry* 1 box / 1 bag*	20% wheat* 30% oat* 30% fruits & nuts** 1 box / 1 bag*
*minimum	*minimum	*minimum	*minimum	*minimum	*minimum **requires all fruits/nut

FIXED COSTS (€ paid each 5 days)*

Labor	20 000
Manufacturing overhead	15 000
S, G & A	40 000
Depreciation (Building)	1 250
Depreciation (Equipment)	50 000

*Billed automatically

STORAGE CAPACITY AND COSTS

Product Type	Current Space	Daily Cost per additional 50 000 units*	Daily Carbon cost per additional 50 000 units*
Finished products	250 000 boxes	€500	2 500 (kg of CO_2e)/day
Raw materials	250 000 kg	€1 000	5 000 (kg of CO_2e)/day
Packaging (bags and boxes)	750 000 units	€100	1 500 (kg of CO_2e)/day

*Billed automatically

DAILY OVERHEAD CARBON

Purchased Energy (kg of CO_2e)	500
Other Overhead (kg of CO_2e)	400

PRODUCTION CONSTRAINTS

Capacity (units/day)	24 000
Additional Capacity Cost (€ per 1 000 units)	1 000 000**
Additional Capacity Carbon Emission (kg per 1 000 units)	1 000
Production Carbon Emission	0.30 kg per box
Setup Carbon Emission	50 kg per hour
Minimum/Maximum Lot Size	16 000/48 000

**Investing in additional capacity will increase equipment depreciation costs

SUPPLIERS

Vendor	V01	V11	V02	V12
Lead time (days)	2-3	1-4	2-3	1-4
Delivery Cost (euros)	-	€ 1 000	-	€ 2 000
Delivery Carbon (kg of CO_2e)	10 000	10 000	6 000	15 000

CUSTOMERS

DC10 — **DC 10: Hypermarkets**
Payment Time: 20 days
Approximate Market Size
€90 000 per team per week

DC12 — **DC 12: Grocery Chains**
Payment Time: 10-20 days
Approximate Market Size
€360 000 per team per week

DC14 — **DC 14: Independent Grocers**
Payment Time: 1-20 days
Approximate Market Size
€135 000 per team per week

TRANSPORTATION AND CARBON FEES

Movement type	Cost (€)	Carbon (kg)
Main Warehouse to Regions	500	750
Regions to Customers	-	200
Main WH to Customers (per unit)	0.05	0.25

FIXED CARBON TAX

Price (€/kg of CO_2e)	0.20

SUSTAINABLE INVESTMENTS

Type	Cost (€)	Carbon (kg of CO_2e)	Reduction (%)	Max. Reduction (%)
Freight Fleet Improvement	10 000	2 000	15	45
Sustainable Manufacturing	10 000	2 000	15	45

SETUP TIME REDUCTION

Setup time (hrs)	Cost (€)	Carbon (kg)
8	-	-
7	50 000	100
6	125 000	250
5	250 000	500
4	500 000	1 000
3	1 250 000	2 500

2/2

Rounds Evolution

Round 1

- No carbon tax
- Sales from the main warehouse only
- Standard investments allowed

Round 2

- Carbon tax now implemented
- Suppliers V11 and V12 now available
- Sustainable investments allowed
- ZITM enabled

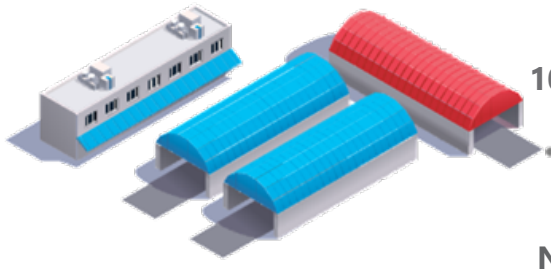
Round 3

- Increased carbon tax
- Sales from regional warehouses now available
- Random disruption

Round 4

- Increased carbon tax
- Random disruption

Round 4 – Scenario



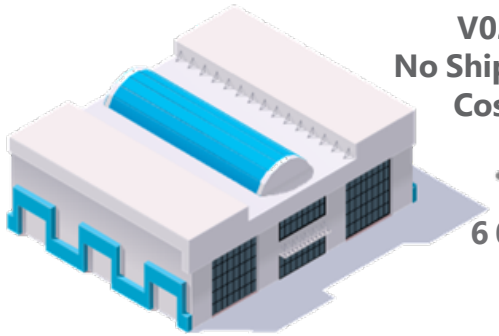
SUPPLIERS V01 - V11

V01
10 000 kg of CO_2e
per PO

V01
No Shipping Cost

V11
10 000 kg of CO_2e
per PO

V11
€1 000
per PO



SUPPLIERS V02 - V12

V02
No Shipping Cost

V12
€2 000
per PO

V12
15 000 kg of CO_2e
per PO

V02
6 000 kg of CO_2e
per PO

Carbon Tax: **€0.65**
per kg of CO_2e
(Round 3&4 €0.30)

MAIN WAREHOUSE

Carbon emission for purchased energy
250 kg of CO_2e / day
(instead of 500 kg)

1 000 kg of CO_2e
per Transfer

500 kg of CO_2e
per Transfer

€500
per Transfer

1 250 kg of CO_2e
per Transfer

REGIONAL LOCATIONS

200 kg of CO_2e
per Sales Order

No Shipping Cost

€0.05
per Unit

0.35 kg of CO_2e
per Unit

DC 10, 12, 14 (CUSTOMERS)

Random Disruptions

1) Cold Spell

- Higher carbon emissions per unit of raw material purchased
- Lower storage energy

2) Heat Wave

- Higher carbon emissions per unit of raw material purchased
- Higher storage energy

3) Disruption in Supply Chain

- Less-optimal sourcing and routing
- Higher carbon emissions for all products purchased

4) New legislation

Renewable Energy Adoption

- Higher carbon tax
- Lower energy footprint

5) Waste Heat Recovery System

- Lower energy consumption
- Higher maintenance needs

6) Main Warehouse Relocation

- Increased distance between main-hub and two regions as well as Germany
- Reduced the distance to the third region
- Impact on carbon emissions from deliveries

1

Cold Spell

The cold spell increases the carbon emissions per unit of raw material purchased, as suppliers must use energy-intensive protection measures to protect the fruits, nuts, cereals from the cold.

However, your company requires less energy to stick them in a cool environment.

2

Heat Wave

The heat wave increases the carbon per unit of raw material purchased, as suppliers must use energy to protect the fruits and/or nuts from the intense heat before the harvest.

Furthermore, your company requires more energy to stock them in a cool environment.

3

Disruption in Supply Chain

Disruptions in your supplier's supply chain require them to use less-optimal sourcing and routing.

Therefore, all products purchased from this supplier will be generating more carbon emissions.

4

New Legislation

Renewable Energy Adoption

New legislation in Germany increases drastically the carbon tax while reducing the carbon footprint of purchasing energy as more energy is now generated by renewable sources.

5

Waste Heat Recovery System

Newly installed waste heat recovery system on your machineries allow your company to reuse heat from your production process, thus reducing the amount of energy purchased. A newly installed waste heat recovery system on your machines allows your

However, the more complex machineries require more care when cleaning up between production batches.

6

Main Warehouse Relocation

A recent relocation of your main warehouse increases the distance between your main hub and two regions and Germany while reducing the distance with the third region.

The distance difference will be impacting the carbon emissions generated by deliveries from the main warehouse to the regions and by sales delivered directly from the main warehouse.

Random Disruptions

Event	Name	Context	Scope
1	Cold Spell	The cold spell increases the carbon emission per unit of raw material purchased, as suppliers must use energy-intensive protection measures to protect the fruits/nuts/cereals from the cold. However, your company requires less energy to stock them in a cool environment.	All suppliers, 2 random raw materials
2	Heat Wave	The heat wave increases the carbon per unit of raw material purchased, as suppliers must use energy to protect the fruits and/or nuts from the intense heat before the harvest. Furthermore, your company requires more energy to stock them in a cool environment.	All suppliers, 2 random raw materials
3	Disruption in Supply Chain (Vendors)	Disruptions in your supplier's supply chain required them to use less-optimal sourcing and routing. Therefore, all products purchased from this supplier will be generating more carbon emissions.	Random suppliers, All products
4	New Legislation, Renewable Energy Adoption	New legislations in Germany increases drastically the carbon tax while reducing the carbon footprint of purchasing energy as more energy is now generated by renewable sources.	-
5	Waste Heat Recovery System	Newly installed waste heat recovery system on your machineries allow your company to reuse heat from your production process, thus reducing the amount of energy purchased. However, the more complex machineries require more care when cleaning up between production batches.	-
6	Main Warehouse Relocation	A recent relocation of your main warehouse increases the distance between your main hub and two regions and Germany while reducing the distance with the third region. The distance difference will be impacting the carbon emissions generated by deliveries from the main warehouse to the regions and by sales delivered directly from the main warehouse.	Random regions

Round 4 - Random Disruption

1) Cold Spell

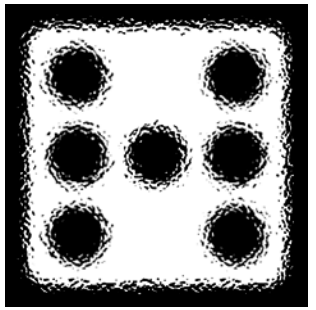
2) Heat Wave

3) Distruption in Supply Chain

4) New Legislation Renewable Energy Adoption

5) Waste Heat Recovery System

6) Main Warehouse Relocation



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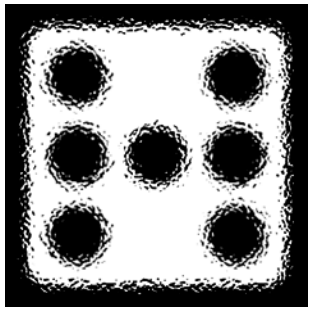
Disruption 1 – Cold Spell

Main Impact	Impact 2	Impact 3	Impact on students' strategies
Increase carbon per unit purchased	Decrease carbon for overstocking raw materials and finished goods	Decrease slightly carbon for purchased energy	Students must assess whether to continue ordering the affected raw materials. If they decide against it, they may need to revise their production, sales, and marketing strategies accordingly.

Impact	Default values	New values
Carbon emission per unit purchased for the impacted raw materials	Product-dependant	+2.5 kg/unit
Carbon emission for overstocking raw materials	5 000 kg/container	-2 500 kg/container
Carbon emission for overstocking finished goods	2 500 kg/container	-1 000 kg/container
Carbon emission for purchased energy	500 kg/day	-100 kg/day

Event	Raw Material Impacted
1	Nuts and Strawberries
2	Nuts and Blueberries
3	Nuts and Raisins
4	Strawberries and Blueberries
5	Strawberries and Raisins
6	Blueberries and Raisins



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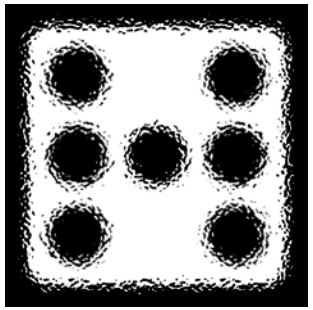
Disruption 2 – Heat Wave

Main Impact	Impact 2	Impact 3	Impact on students' strategies
Increase carbon per unit purchased	Increase carbon for overstocking raw materials and finished goods	Increase slightly carbon for purchased energy	Students must assess whether to continue ordering the affected raw materials. If they decide against it, they may need to revise their production, sales, and marketing strategies accordingly.

Impact	Default values	New values
Carbon emission per unit purchased for the impacted raw materials	Product-dependant	+2.5 kg/unit
Carbon emission for overstocking raw materials	5 000 kg/container	+2 500 kg/container
Carbon emission for overstocking finished goods	2 500 kg/container	+1 000 kg/container
Carbon emission for purchased energy	500 kg/day	+100 kg/day

Event	Raw Material Impacted
1	Nuts and Strawberries
2	Nuts and Blueberries
3	Nuts and Raisins
4	Strawberries and Blueberries
5	Strawberries and Raisins
6	Blueberries and Raisins



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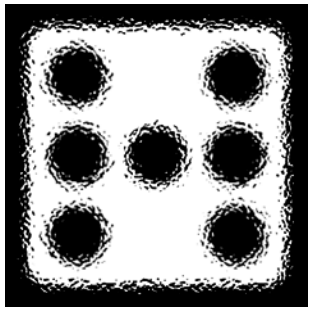
Disruption 3 – Supply Chain (vendors)

Main Impact	Impact 2	Impact 3	Impact on students' strategies
Increase carbon for procurement goods movements	Increase carbon per unit purchased		Students must determine whether to continue ordering from the affected suppliers. If they choose not to, they may need to adjust their procurement strategies.

Impact	Default values	New values
Carbon emission for procurement goods movements from the impacted suppliers	Supplier-dependant	+3 000 kg/movement
Carbon emission per unit purchased from the impacted suppliers	Product-dependant	+1.00 kg/unit

Event	Suppliers Impacted
1	V01 and V02
2	V01 and V12
3	V11 and V02
4	V11 and V12



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Disruption 4 – New Legislation and Renewable Energy Adoption

Main Impact	Impact 2	Impact 3	Impact on students' strategies
Increase significantly carbon tax	Decrease carbon for purchased energy		The significant rise in the carbon tax will compel students to reassess how their carbon emissions affect their profitability and reevaluate their operations.

Impact	Default values	New values
Carbon tax	0.30 €/kg CO2e	+0.25 €/kg CO2e
Carbon emission for purchased energy	500 kg/day	-250 kg/day

Disruption 5 – Waste Heat Recovery System

Main Impact	Impact 2	Impact 3	Impact on students' strategies
Decrease carbon per unit produced	Increase carbon for setup time	Decrease carbon for purchased energy	Increasing carbon emissions during setup time while reducing carbon emissions during production will require students to reassess their investment strategies and to optimize their production schedule.

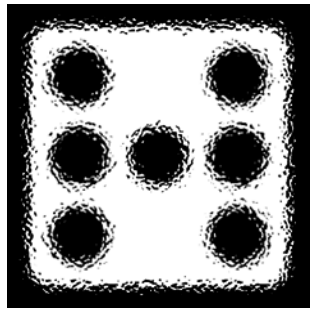
Impact	Default values	New values
Carbon per unit produced	0.30 kg/box produced	-0.15 kg/box produced
Carbon per hour of setup time	50 kg/hour	+200 kg/hour
Carbon emission for purchased energy	500 kg/day	-200 kg/day

Disruption 6 – Main Warehouse Relocation

Main Impact	Impact 2	Impact 3	Impact on students' strategies
Increase carbon for internal goods movement toward 2 regions	Decrease carbon for internal goods movement toward one region	Increase slightly carbon for sales from the main warehouse	The substantial rise in carbon emissions in two regions, coupled with a decrease in another, requires students to reassess their decision to sell in these regions. Furthermore, the increase in carbon emissions when selling from the main warehouse should incite students to use the regional warehouses.

Impact	Default values	New values
Carbon for internal goods movements toward the new region of the warehouse	750 kg/movement	-250 kg/movement
Carbon for internal goods movements toward the second closest region	750 kg/movement	+250 kg/movement
Carbon for internal goods movements toward the farthest region	750 kg/movement	+500 kg/movement
Carbon from sales from the main warehouse	0.25 kg/unit moved	+0.10 kg/unit moved

Event	New Main Warehouse Location
1	Moved to the North closer to the West
2	Moved to the North closer to the South
3	Moved to the South closer to the North
4	Moved to the South closer to the West
5	Moved to the West closer to the South
6	Moved to the West closer to the North



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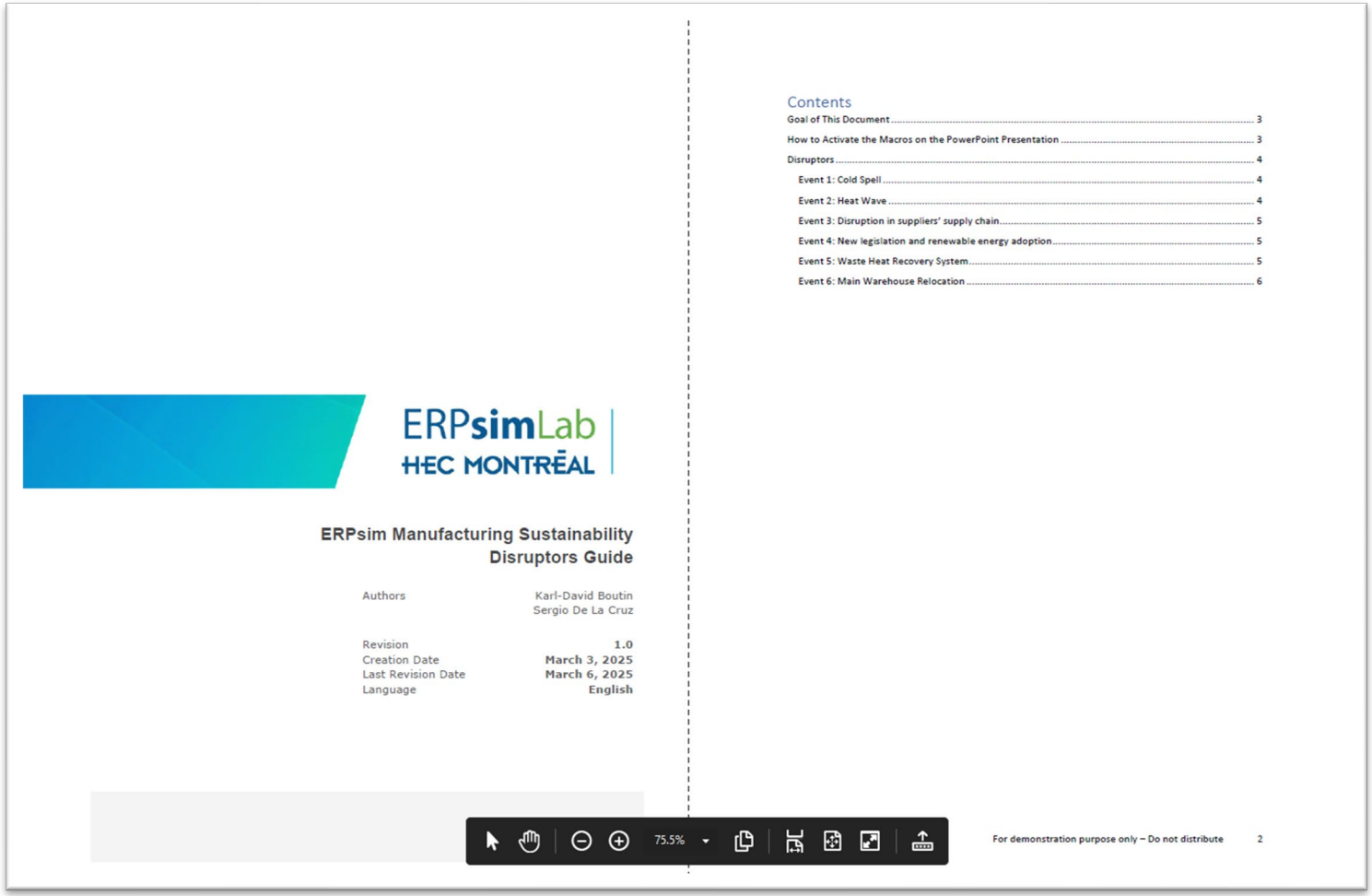
ERPsim Disruptions Toolset

ERPsim Academic Edition

Disruptors Guide



ERPsimLab
HEC MONTRÉAL

ERPsim Manufacturing Sustainability
Disruptors Guide

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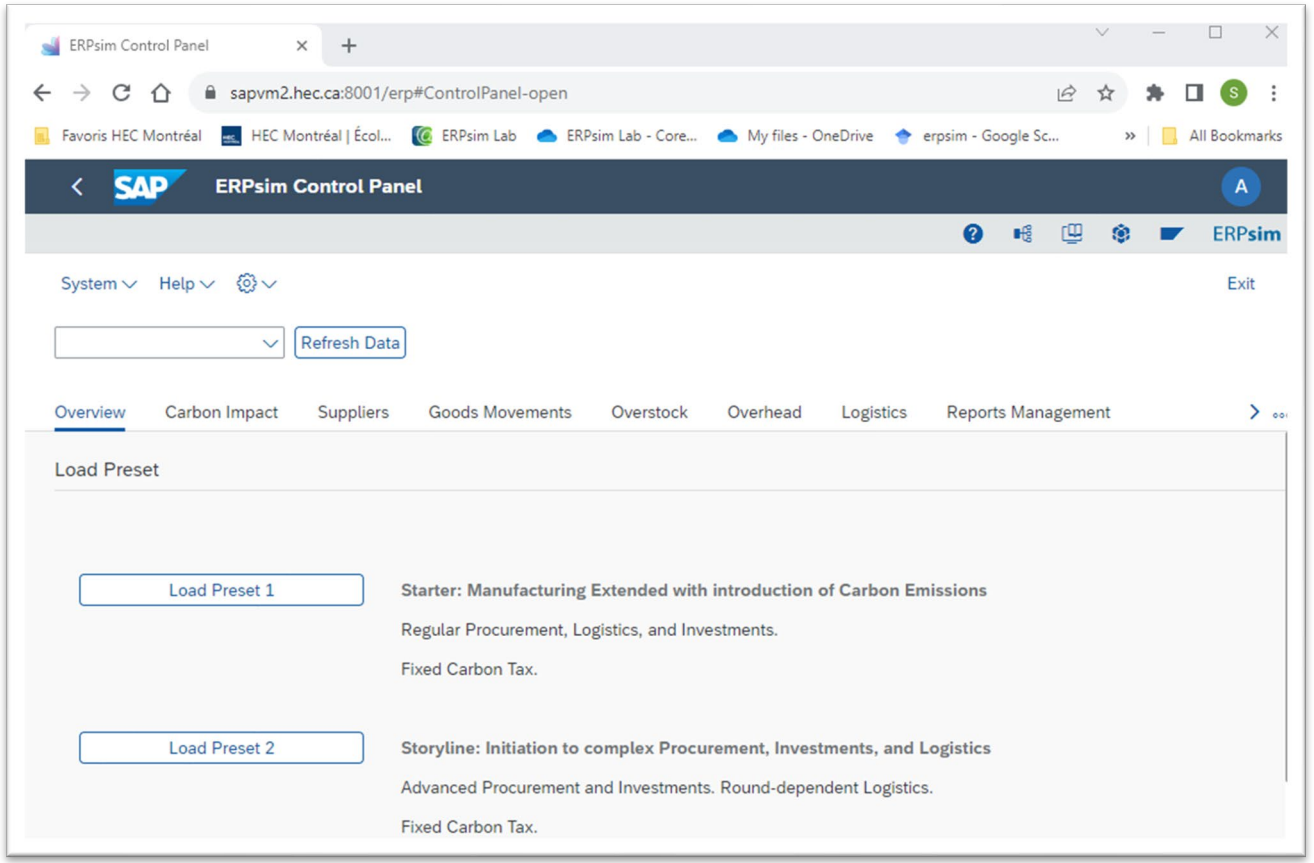
75.5%

ZCONTROL

https://erpsim.hec.ca/en/node/148

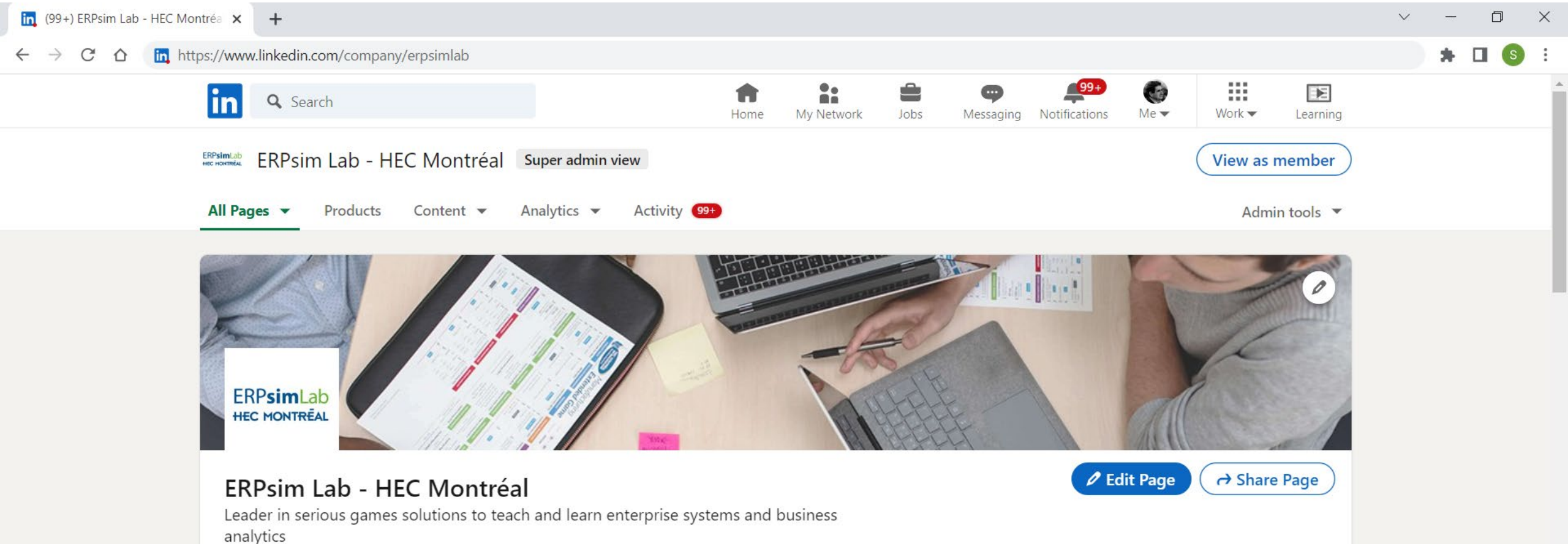


Other Elements of Surprise

- OData: unavailable, for own team, for all teams
- Digital Transformation: round-by-round discovery
- ZLINK: Disclose information as game is played
- Inherit a company:
  - Mid-game teams' switch
  - Play a few rounds on-behalf, start the game on Round N
- Lock access to the system
- Sustainability: variable carbon tax, reports for a fee, single or multiple vendors, selling location (MW, Regions, both), sustainable investments, determine carbon sources (overhead, production,…)

Q&A Toolset

linkedin.com/company/erpsimlab



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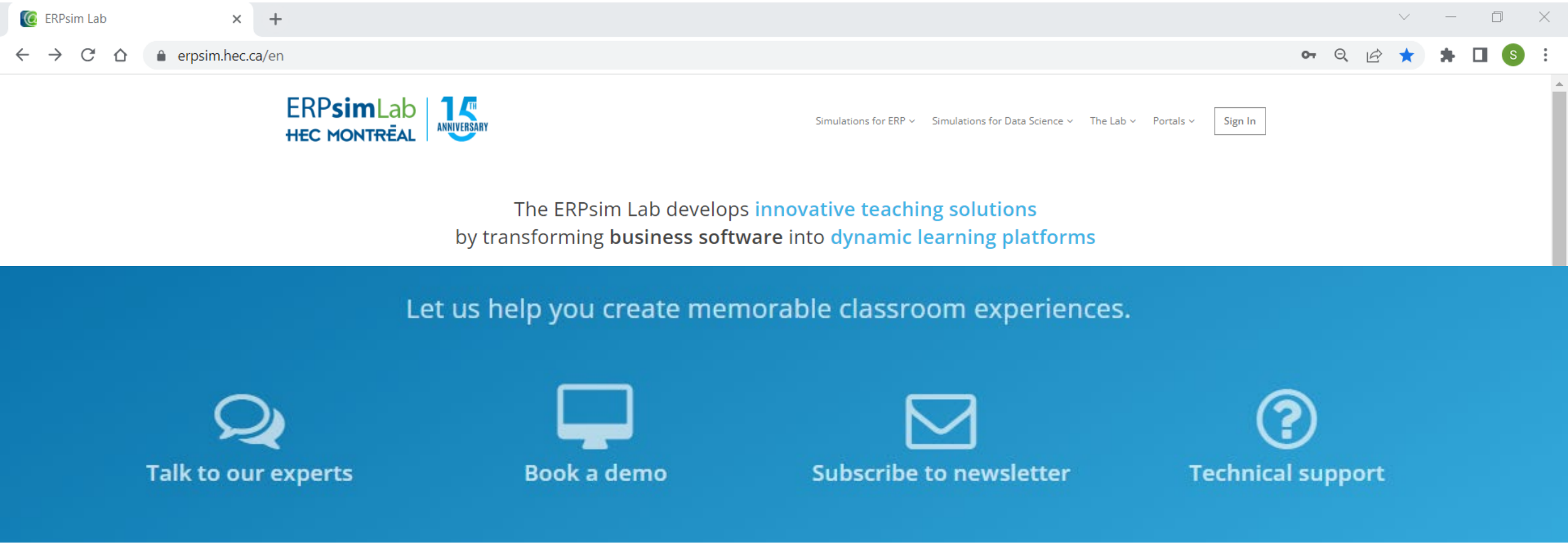

Thank You!

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