A model and method for customization of simulation games

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ELEC 2016
Author’s bio

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Agenda

- On the use of simulation and training games
- Motivation for the research
- Model and method for customization of simulation games
- Summary and outlook
Facilitating transformation

- Influencing factors on change
  - Understand the need for change (i.e. the burning platform)
  - Understand the proposed change or solution
  - Understand the consequences and why the solution is better than current practice

- Games and simulation can be a catalyst for latter two
# Simulation vs. game?

<table>
<thead>
<tr>
<th></th>
<th>Simulation</th>
<th>Game</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of detail</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Domain identification</td>
<td>High</td>
<td>Low/medium</td>
</tr>
<tr>
<td># of scenarios</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Involvement</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Sense of ownership</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Tactile</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Purpose</td>
<td>Optimization</td>
<td>Training / motivation</td>
</tr>
<tr>
<td>Method</td>
<td>Virtual</td>
<td>Physical</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Low</td>
<td>High</td>
</tr>
</tbody>
</table>
EVALUATION OF GAMES
Literature review

- **Hands-on gaming enhances learning**
  - Elbadawi, I., McWilliams, D.L. & Tetteh, E.G. 2010, "Enhancing Lean Manufacturing Learning Experience Through Hands-On Simulation", *Simulation & Gaming*, vol. 41, no. 4, pp. 537-552

- **The use of games is better than lectures for learning**
  - Smith, E.T. & Boyer, M.A. 1996, "Designing In-Class Simulations", *PS: Political Science and Politics*, vol. 29, no. 4, pp. 690-694

- **Realistic scenarios that have the same decision scenarios enhances retention of training**
  - Niehaus, James & Riedl, Mark, "Scenario Adaptation: An Approach to Customizing Computer-Based Training Games and Simulations", Gatech
  - Riis, J. 1994, "Games In Production Management", *Production Planning & Control*, vol. 5, no. 2, pp. 229-233
Findings from literature review

- Learning has biggest effect when training or teaching is tactile
  - i.e. use games and exercises
- Effect is bigger when participants can relate to the situation/experience in the game
  - i.e. adapt the game to situation
- No approach yet to make adaptation easier
Dilemma

- Why do we need to customize training games when there is a wealth of available games for either sale or free?

- For an overview of games available see
  - They mention the need for making games as realistic as possible but does not point to customization explicitly
Classification of games

Knowledge application

- Internal
  - Eyeopener
  - Buckingham Lean game
  - Beer game
- External
  - What’s in it for me
  - Specific
  - General
  - 5S
  - SMED
  - LEGO serious play
  - Ahh. That’s how
  - Kata game
  - Let’s start changing

Domain application

Ahh. That’s how

Let’s start changing
TRIZ model for learning from games

Adopted from TRIZ
Hypothesis

- The effect of games is greater if the game set-up and in-game decisions resembles your own situation

- We don’t have evidence yet
To sum up so far …

- Games have a positive effect on learning
- The effect is increased if the environment resembles your own
- The effect is further increased if the decisions in the game resembles your own

- The gab is
  - Most games have a fixed layout (resources, products, etc.)
  - So far no documented way of customizing games

- There is a need for a method and a model for how to customize games for a specific situation
THE PROPOSED SOLUTION
Literature review

- **Using VSM as base-point for building a PC-based simulation model**
  - Xia, W. & Sun, J. 2013, "Simulation guided value stream mapping and lean improvement: A case study of a tubular machining facility", *Journal of Industrial Engineering and Management*, vol. 6, no. 2, pp. 456-576

- **Using simulation to validate future state map**

- **Simulation to validate future state and the use of templates when building model**

- **Explore implementation issues with a simulation model**

- **Describes gaming simulation design with a focus on designing human-interaction games**
  - Kriz, W.C. 2003, "Creating Effective Learning Environments and Learning Organizations through Gaming Simulation Design", *Simulation & Gaming*, vol. 34, no. 4, pp. 495-511
Findings from literature review

- Use VSM as a basepoint for creating the game
- Use the customized game to validate the current state
- Allow realistic changes in the game to explore options and possibilities for improvements i.e. do not use a fixed game-play
It is more complex to customize games than to link general game to my settings!

... or is it?
Flow of developing a simulation game

Idea (process and purpose) → Structure → Collect data → Create model → Simplify / expedite → Conceptualize or codify → Simplify / expedite → Play game and learn

Templates → Templates
Customization effort

Level of detail in game

Simplify

Codify
Structuring data collecting

**Tangibles**
- Resource
- Inventory
- Transportation

**Intangibles**
- Layout
- Organization & structure
- Planning

**Input**
- Demand
- Raw material

**Model**

**Output**
- Finished goods
- Scrap
- KPI's

**Based on purpose:**
- Decide what’s important
- Resource could be plant for SCM
Input

- Demand
  - Product & variant
  - Volume
  - Variation over time
  - Seasonality
  - Lead time requirement per product/variant

- Raw material
  - BOM
  - Supplier lead-time
  - Variation in supplier lead-time
Output

- Finished goods
- Scrap
- KPI’s

**Finished goods**
- Void

**Scrap**
- Returns & re-shipments
- Warranty / claims

**KPI’s**
- Delivery performance: OTIF
- Productivity
- Utilization
- Scrap level
- Financials
- WIP
- Inventory (RM/FG)
Tangibles

- Resource
  - Process time / Production rate
  - Max process batch
  - Production batch size
  - Availability
  - Process failures (types / level)
  - FPY
  - # operators
  - Variant constraints
  - Maintenance
  - Routing
  - Parts/information: input, source, output (pr. output)
  - Quality inspection / approval

- Inventory
  - Max inventory level (constraint)
  - Inventory policy (FIFO, LIFO)
  - Variant constraints
  - Current inventory level

- Transportation
  - Transportation time
  - Max transportation batch
  - Availability
  - Process failures
  - # operators
  - Variant constraints
Intangibles

- **Layout**
  - Spaghetti diagram
  - Layout plan

- **Organization & structure**
  - # employees
  - Competency matrix
  - Organizational structure
  - Empowerment (what can the employee decide themselves)
  - Approval policies

- **Planning**
  - MRP policies (lead-time offset, safety stock/time)
  - Lot size policies
  - CONWIP / Kanban policies
  - Variant creation pattern
Create model

- Demand considerations
  - Products from A, B & C (limit no. of products to 4-10)
    - Dedicated flows,
  - Variants
  - Demand changes
  - Scale demand to codified flow capacity (depends on codified model)

- Flow considerations
  - Focus on the most important resources and activities e.g. leave out maintenance if it is not a concern
  - Simplify reporting and documentation during game (may be the most important in a pharmaceutical environment though)
Codify

- Products
- Processes
- Variation
Codify - Products

- Lego
- Stickle bricks
- Plus-plus
- Paper
- Cards

- Variants
  - Shape / form
  - Color
Codify - Process

- Assemble
- Cut / glue / draw / color
- Calculate / write / fill in
- Fold (origami)
Codify - Variation

- Demand
  - Shuffle orders
  - Change takt
- Process
  - Dice
- Natural variation

![Image of a metronome and cards being shuffled, with a bell curve graph and dice illustrations.]
Summary

- Change is enabled by better understanding of purpose and solution
- So far no formal model for customizing games
- A first model and method is developed

Future needs
- Verification of effect of customized games
- Object-oriented or template like method to further simplify model creation
- Case of using a customized game