Enhancing Robotic Arc Welding by Reducing Costs in Programming

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The Illusion of Knowledge

Illusion of Knowing, is a phenomenon that may hinder effective learning since participants do not know when they have missed critical information. One explanation is that participants cannot see everything to get a signal of error - a signal corresponding to something that is not understood. Lund University Cognitive Science, Kungshuset Lundagård, 222 22 Lund, Sweden

It is impossible to comprehend a total manufacturing process with all the interoperability and dependencies between operations by simply “Genchi Genbutsu” i.e. “Go and See” or “Gemba” i.e. “The real place” indicating the only way is to observe it on the shop floor. Dr. Robert J. Axtman
The Theory of Constraints

*The Theory of Constraints* assumes that the rate of increasing manufacturing profitability is limited by at least one constraining process.

The theory then goes on to state that the only way to improve the manufacturing profits is to increase the throughput on that given constraint.
This presentation will emphasize a focused view of the benefits of this technology that encompasses all the facets of any enterprises production environment and specific to Arc Welding.
What is Simulation

- the imitation of an operation for a real-world process or system over time
- involves the generation of an artificial history of a system
- observation of that history to draw characteristics of a real system that is to be developed

(Jerry Banks, 1998; *The Handbook of Simulation*)
What is Simulation

- is an indispensable problem-solving methodology for the solution of manufacturing problems
- is used to describe and analyze the behavior of a system or process
- provides ability to ask what-if questions
- capability to model existing & concept systems

(Jerry Banks, 1998; The Handbook of Simulation)
What is Simulation

• Manufacturing simulation focuses on modeling the behavior of manufacturing organizations, processes, and systems.

• Organizations, processes and systems include supply chains, as well as people, machines, tools, and information systems.

Charles McLean and Swee Leong
National Institute of Standards and Technology
For example, manufacturing simulation can be used to:

- Model “as-is” and “to-be” manufacturing supporting operations from the supply chain level down to the shop floor
- Evaluate the manufacturability of new product designs
- Support the development and validation of process data for new products
- Assist in the engineering of new production systems and processes
- Evaluate resource allocation and scheduling alternatives
- Analyze layouts and flow of materials within production areas
- Perform capacity planning analyses
- Determine production and material handling resources
- Train production and support staff on systems and processes
- Develop metrics to allow the comparison to support continuous improvement of manufacturing operations
Other examples of manufacturing simulation applications include:

- the modeling and verification of discrete and continuous manufacturing processes
- offline programming of robots and other machinery
- site selection
- layout planning
- process and system visualization
- ergonomic analysis of manual tasks and work area layout
- evaluation of scheduling algorithms and dispatching rules
- business process engineering
Simulation models are built to:

• support decisions regarding investment in new technology
• expansion of production capabilities
• modeling of supplier relationships
• materials management
• human resource management

and so forth – thus simulation supports many, if not all, of the strategic manufacturing target areas.
• Manufacturing systems, processes, and data are growing ever more complex.
• Product design, manufacturing engineering, and production management decisions often involve the consideration of many interdependent variables.
• These decisions often have a long-term impact on the success or failure of the manufacturing organization.
• It is extremely risky to make these major decisions based on “gut instinct” alone.

• **[3D]** Simulation provides a capability to rapidly conduct experiments to predict and evaluate the results of alternative manufacturing decisions.

• It has often been said that you do not really understand your industrial processes and systems until you try to simulate them.

Is 3D Simulation technology affordable?
The answer...

It depends upon the user.
- the company’s resources
- availability of discretionary funds
- simulation skills and experience base of current staff or consultants
- existing information systems infrastructure
- scope and complexity of the target simulation application area
- availability of turnkey or readily-adaptable simulation models
- availability and format of input data
- cost & risks of implementing manufacturing systems without the use of simulation
Another factor Inhibiting the Use of 3D Manufacturing Simulation is the Cost of Simulation Technology Licensing.

A more complete picture of the cost factors in the deployment of simulation technology includes:
• Computing hardware and peripheral devices
• Initial software licenses, options (plug-ins, translators, analysis tools), and maintenance upgrades
• Salaries of manufacturing domain experts, simulation specialists, consultants, and support staff
• Training classes, learning curves, and maintaining proficiency
• Requirements analysis and data acquisition
• Translation of existing company data
• Systems integration with other related manufacturing software applications and/or databases
• Development, maintenance, and configuration management of simulation models.
“I wish you would update your simulation software so we could do away with the 3D glasses.”
Another question...

What is the Cost to NOT Simulate?
According to an Industry Analyst (CIMdata) report entitled “The Benefits of Digital Manufacturing,” organizations using digital manufacturing technologies can potentially realize tremendous production improvements and reductions in resource waste, including:

- 30 % reduction in lead time-to-market
- 40 % reduction in manufacturing process planning
- 15 % increase in production throughput
- 13 % decrease in overall production cost
- 40 % reduction in equipment costs
We have asked (2) two basic questions in this session

What is the Cost to NOT Simulate?
CIM data research indicated:

• 30 % reduction in lead time-to-market
• 40 % reduction in manufacturing process planning
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Is 3D Simulation technology affordable?
Finding the *Hidden Treasure*

**Example:**
- A part cost $20 to manufacture (including non-value added costs)
- Current production rate is 100 parts / hour
- Part Sells at $60
- Profit of $40 / part
- Increase production throughput by 5% (conservative %).

**Results:**
- Increase of 5 parts / hour for a total of 105 / hour
- 5 parts / hour x $40 / part x 8 hours / day = +$1,600 / day
- $1,600 / day x 5 days / week x 4 weeks / month = +$32,000 / mth.
- $32,000 per month x 12 months = $384,000 per year

*If you apply the analyst findings of 15% you would find a “Hidden Treasure” of $1,152,000*
References:


Charles McLean and Swee Leong; National Institute of Standards and Technology

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“It is essential to hold on to your values but wise to evaluate their worth from time to time as conditions influence change.”
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