MARCH | 2021

INDUSTRIALIZATION OF CONSTRUCTION®: SIGNAL OR NOISE? THREAT OR PROMISE?

PHASE III: ADVANCED MODEL DEVELOPMENT

Commissioned by ELECTRI International. Conducted by MCA Inc.
Researchers: Dr. Heather Moore, Dr. Meik Daneshgari. Assistant Researcher: Sydney Parvin

ELECTRI INTERNATIONAL
Research and Education for the Electrical Construction Industry

Phase III: Advanced Model Development

When Henry Ford envisioned the assembly line, he may not have foreseen the need for gas stations. When Guttenberg envisioned the printing press, he probably did not have libraries in mind. When Eli Whitney built the first musket, he was not considering the need for bulletproof vests. Each of these pioneers who transferred tacit knowledge to explicit knowledge brought unforeseen expansion that required new regulations, new infrastructure, and new operating models.

Figure 1 *(page 6)* shows a high-level roadmap for the future of the construction industry in the next phases of Industrialization. As we move from Step 2 to Step 3 and beyond, the landscape will require significant shifts in the items shown. Although we cannot be certain about the detail of the elements, we can look back to other industries that have gone this route to predict what could happen in construction. The next sections provide considerations for four major categories of change:

1. Operational model
2. Industry participants
3. New boundaries
4. Results and outcomes

The methods used for bringing this industry-wide shift to fruition correspond to how quickly it could happen. Fruition took one century in manufacturing and three in agriculture, largely due to accessibility to the tacit knowledge and the industry's ability to scale and expand. For example, the know-how of farming resided with the farmer until there was a channel for combining the tacit knowledge across individual farmers.

Know-how of manufacturing resided with the mechanic until there was a channel to expand and learn from all of the mechanics. With limitations on physical travel distances (due to lack of mass transportation) as well as information travel (due to lack of mass application of computing power), the data and information about how to transfer the value of these craftspeople were also limited.

The channels for expansion can and have taken the form of industry associations. In manufacturing, the American Society of Mechanical Engineers (ASME) played a key role in building standards and recommending regulations to allow the expansion of the mechanics' knowledge. ELECTRI International alone, or with other construction industry associations, could also use the results of this research to do the same. The worst case is that an outside entity focuses on the Industrialization Index to go through the five steps of Industrialization, envisions this "new landscape" without boundaries or anchors, and disrupts the entire industry, not only change the landscape, but may leave the current players disoriented and dislocated.

1. Operational model

a. Electrical Construction Operational Model for Industrialization

   i. Reference the *Optimized Operational Model for Maximizing Electrical Contractor's Profitability* (see **Reference 1**) research for operational model elements to consider in the Operational Model design such as:

      1. System Design Principles
      2. Little's Law of Response
      3. Organizational Learning Principles
      4. Process Models (Visibility of Systems and Processes): Dimensions of Quality
      5. Team Technology: Dimensions of Information Control

      In addition, Industrialization will require a third dimension to the "Professional Operational Model," for the collective tacit knowledge gathered across businesses' Corporate Memories.

   ii. Development and utilization of an operational database to facilitate processes, procedures, and technology that support the work (see more information about this in **Reference 4**). Such a system will require the workforce from field to PM to managers/executives to:

      1. Work with data more than "gut feel" and tacit knowledge.
      2. No longer relying on "good guys" for productivity and profitability. System productivity will be more important and will require data in order to manage.

   iii. Portfolio management and product lifecycle management.

   iv. More collaboration and less isolation across the entire supply chain.

      1. Historical transactional (buy/sell, output-related) relationships transfer to become value transfer relationships with consumer/outcome in mind.

b. Utilization of elements in the Application Guidebook (Deliverable 2 of this research), including expansions of the elements, learning, and feedback that are measurable using the Industrialization Self-Evaluation.

2. Industry participants

a. Role of associations:

   i. Representing, collecting, and using collective tacit knowledge

   ii. "Making it happen" vs. sharing "current" best practices

   iii. Research, education/training, clinical application

   iv. Learning and standards-setting

b. Change in owner expectations:

   i. Balance and improvement in Time, Cost, and Quality (TCQ)

   ii. Increased expectations for:

      1. Quality

2. Safety
3. Ease of access to the product

iii. Buyer-beware behavior changes to seller-beware

c. Construction supply chain disruption

i. Evolution, or disruption, to get to the 2nd, 3rd, and 4th Generations of Distribution (see more information and explanation on this in **Reference 5**).

ii. Application of Logistics-Centric Model for reducing redundancies of raw materials, sub-assemblies, and final assemblies to the point of installation (see more information and explanation on this in **Reference 7**).

iii. Development of a "Dealer model" as the customer-facing outlets to use for construction selection and servicing.

iv. Blurring the lines of who does what across the supply chain (see **Reference 2**).

d. New participants and roles, including:

i. Mergers & Acquisitions

ii. Shift in the size of contractors

iii. Increase in larger-sized jobs

1. Supply chain consolidation to provide: services, project management, design (shift in risk to align with shift in roles)

iv. More R&D investment

3. New boundaries

a. Regulations (new and changes to current):

i. Code

ii. Unions (protection of the historical model vs. evolving the purpose to support the next phases of Industrialization)

iii. Financial means and methods

iv. Contracting methods across the supply chain

b. Standards for:

i. Prefabrication (currently in development as *NEIS*, see **Reference 9**)

ii. Supply chain transactions

iii. Quality

iv. Human factors / ergonomics

v. Reduction of manipulations and "options"

c. Technology & innovation

d. Physical limitations

i. Transportation of sub-assemblies

ii. Workforce mobility

4. Results and outcomes

a. Consumers

i. If producers change, customers change and, therefore, the market changes

ii. Examples and parallels:

1. Airline ticketing agents (vs. current virtual environment for ticketing)
2. $5 / day (Henry Ford's solution to increase his workers' wages to allow them to buy more Ford-produced vehicles)
3. Anything that connects humans will happen, just as has happened with transportation and information

b. Global implications

i. Produce in Seattle, build in Denver, install in China

ii. Regulations and standards

c. Industry index / data consortium for continuous improvement

5. Recommended next steps

a. Institutionalize Measurements of Industrialization (lead & lag indicators)

i. Lag: Industrialization Self-Evaluation (see Deliverable 1 from this research)

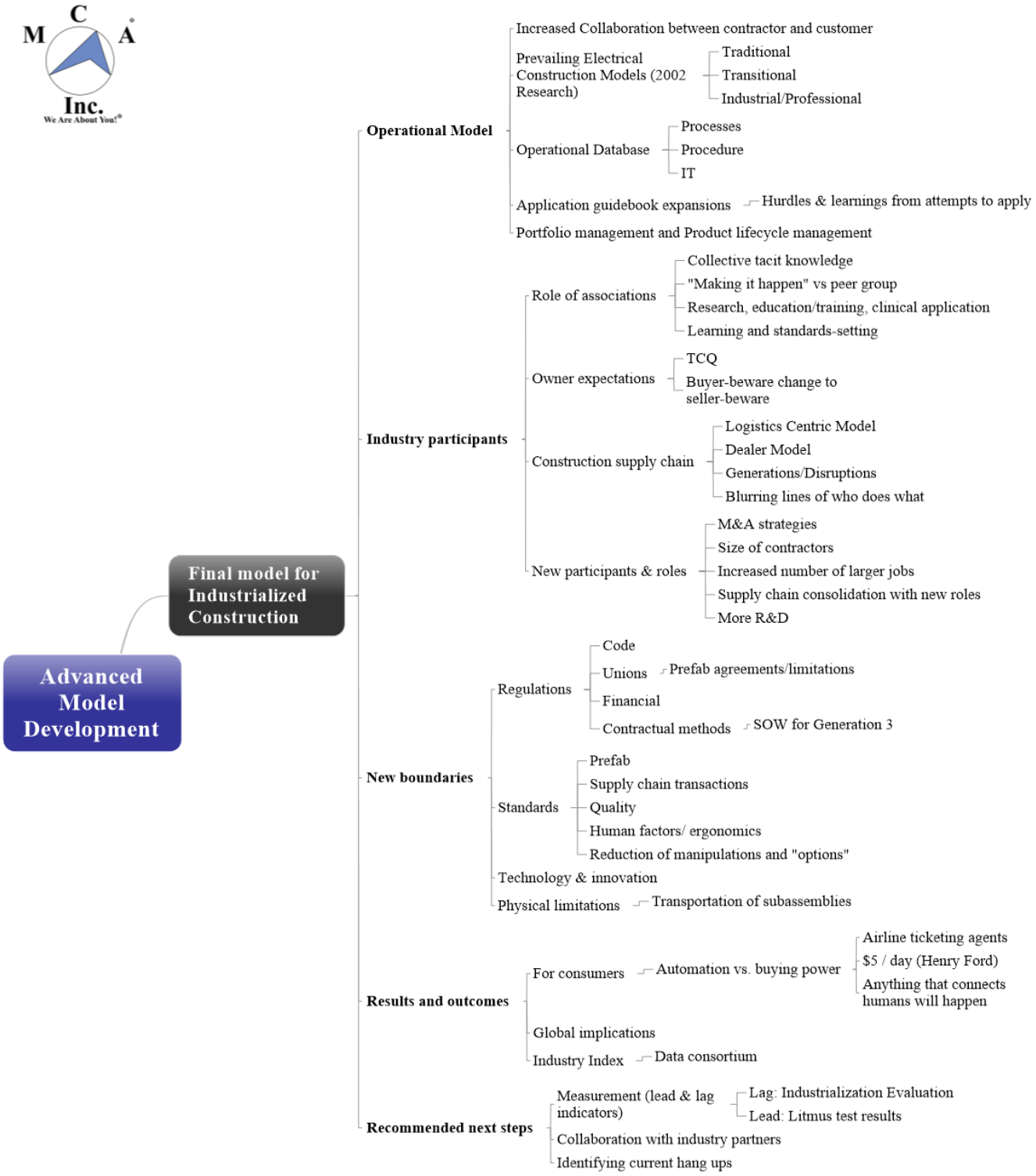
ii. Lead: Litmus test results; amount of work explicitly planned, amount of work externalized, variation in input/process/output

b. Provide ongoing feedback of the Application Guidebook usage

c. Study the feedback of 5a and 5b to determine the biggest "hang-up" over the next year

d. Establish collaborative discussions with other industry groups to draw the boundaries together

Figure 1 – *Roadmap of Landscape Changes During Industrialization of Construction®*



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ELECTRI INTERNATIONAL
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1201 Pennsylvania Ave. NW, Suite 1200 Washington, D.C. 20004
T: 202-991-6300 www.electri.org
Index Number # F3440b