

Construction Automation in North America

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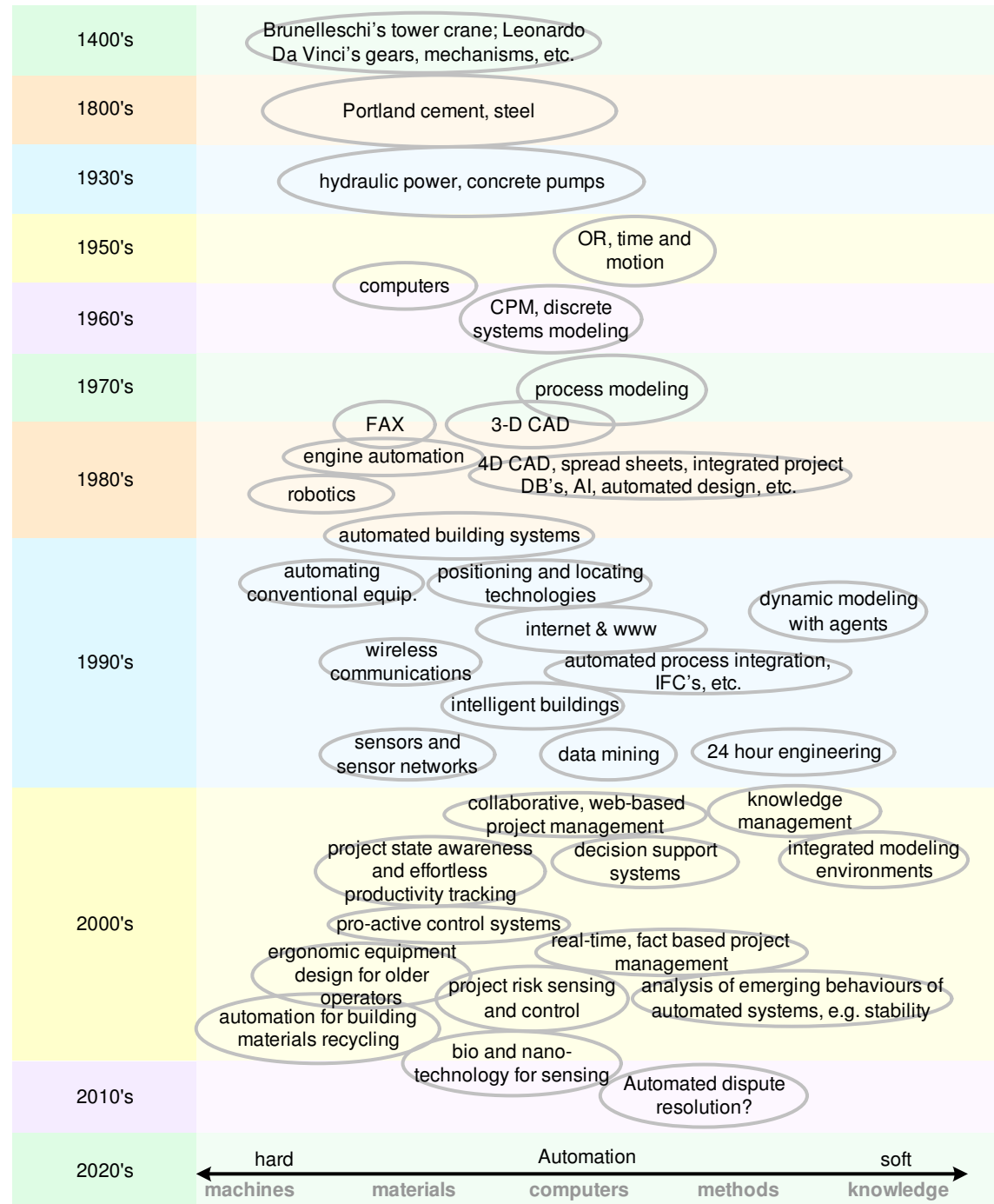
ISARC 2005

Ferrara

Outline

- History of automation in construction
- Categories
- State in each category
- Last thoughts

Brunelleschi to 2020



Categories

1. GPS and laser guided “stakeless” earth moving, paving, and compaction,
2. hand held computers for inspection and quantity tracking,
3. 3D laser scanning (LADAR) for as-built drawings and data generation,
4. concrete maturity sensing and modeling for optimizing concrete placement and expediting bridge and road construction,
5. effortless and automated productivity data gathering,
6. 4D CAD modeling for constructability analysis and for improved communications,
7. web based bidding and project management systems,
8. remote project monitoring with field deployed, web based, video cameras,
9. prefabrication and modularization such as pre-cast pre-stressed concrete panels for rapid intersection replacement,
10. rapid robotic joint repair, pothole repair, and pavement crack sealing,
11. fleet management with GPS and wireless communications, and
12. handheld automated rebar tying.

GPS and laser guided “stakeless” earth moving, paving, and compaction

- Companies and products:
 - John Deere
 - Shimizu
 - Caterpillar:
 - Laser Grade Control System
 - Computer Aided Earthmoving System
 - A complete mining information management system
- These technologies are becoming widely used with acknowledged 50% cost and schedule savings
- Integration with design files is still a problem

Caterpillar's AccuGrade® GPS



hand held computers for inspection and
quantity tracking making inroads

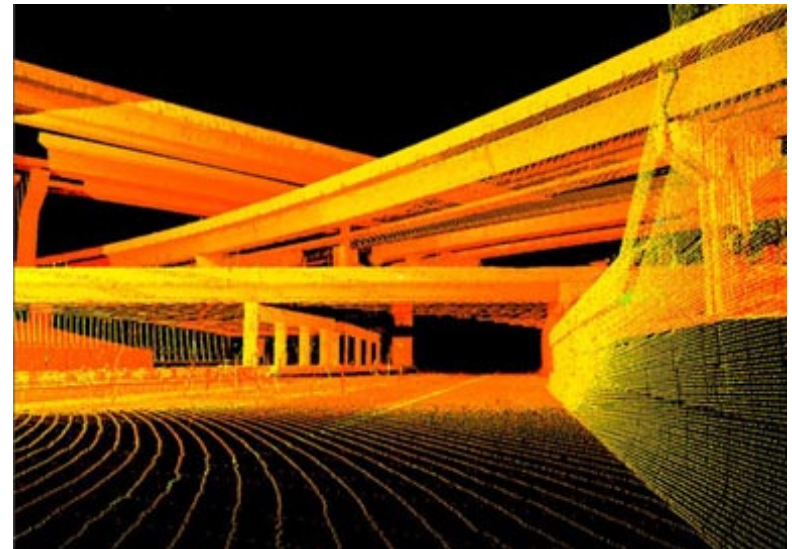


Mobile email and phone devices

- Seeing explosive use growth in construction



3D laser scanning (LADAR) for as-built drawings and data generation being sold as a service by well over a dozen consulting firms in North America



concrete maturity sensing and modeling for
optimizing concrete placement and
expediting bridge and road construction
being used by over 30 state highway
departments

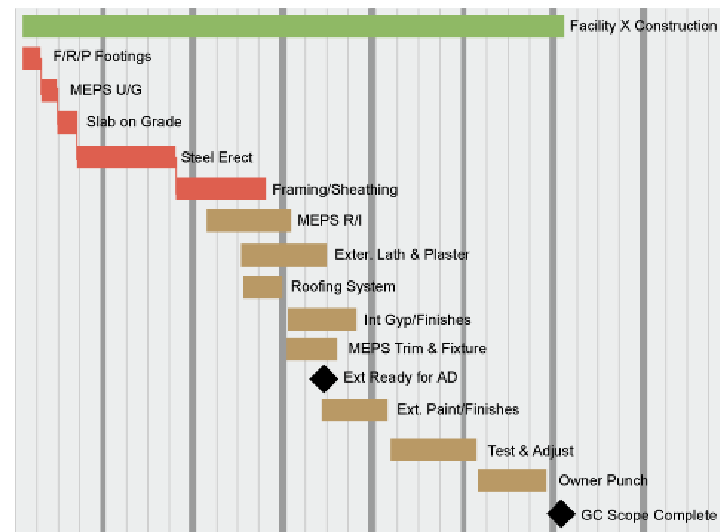
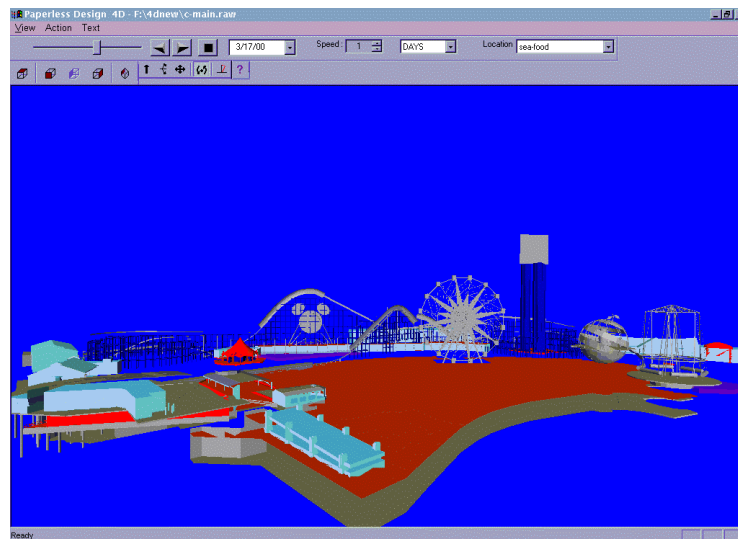


effortless and automated productivity data gathering

- Technion approach:
 - Location Measurement (regular time intervals)
 - Location to Activity Association:
 - Locations
 - Geometry
 - Schedule
 - Decision Rules
 - Progress & Productivity (PPI) Calculations
- Tremendous potential, but not generally in use yet in NA

4D CAD modeling for constructability analysis and for improved communications

- Used by leading engineering construction firms
- Endorsed as a best practice by CII
- 20 years after initial developments at CMU and Stanford



web based bidding and project management systems

- Web based bidding systems being used by majority of state highway departments
- Web based project management systems being used by constructors at \$1B/yr of volume or greater (becoming unmanageable for small players according to reports)
- Example: Prolog by Meridian Systems



Areas with a few initial commercial ventures each but with no great market penetration yet

- remote project monitoring with field deployed, web based, video cameras,
- prefabrication and modularization such as pre-cast pre-stressed concrete panels for rapid intersection replacement,
- rapid robotic joint repair, pothole repair, and pavement crack sealing,

fleet management with GPS and wireless communications, and

- Wide use in trucking for several years
- Beginning to see use in construction in paving projects in particular

And finally, the “holy grail”: handheld automated rebar tying

- Tremendous productivity and ergonomic improvement



Last Thoughts

- The preceding examples demonstrate the extremely variable pace of technology adoption depending on inherent characteristics and application environment
- So the future of construction automation in North America ???:
 - Accelerating implementation
 - Separation into corporate “haves” with critical mass to manage and exploit technology, and “have-nots” who will be marginalized and put out of business (cut-off point at \$1-2 B/yr)
 - Growing skilled labor shortages driving technology adoption
 - Reorganization of the supply chain into much more prefabrication
 - Data acquisition technologies creating a flood of data needing to be processed into decision support and knowledge management systems
 - Continuing relevance of ISARC