How to Maximize the Benefits from Your Railway’s Large Investment in PTC

Sandhouse Gang
Northwestern University
March 15, 2011
Evanston, Illinois

Steven R. Ditmeyer
Adjunct Professor, Railway Management Program
Michigan State University
The Oliver Wyman Report for the AAR is Correct

Railroads are indeed implementing PTC in a way that produces minimal business benefits:

- PTC is not being integrated with precision dispatching systems;
- PTC on-board computers will not know the consist or the size and weight of trains;
- PTC on-board computers will not know the status of locomotive dynamic brakes; and
- PTC is being tied to the wayside signal system and fixed blocks.
Are others getting benefits from the application of the same technology?
Network Centric Warfare

Use integrated digital data communications, GPS positioning, sensors, computers, and displays to obtain:

- Increased operational flexibility
- Increased decision-making speed
- Cost savings due to improved asset utilization
- Improved support to dispersed elements
- Increased visibility and better understanding of operations
- Self-synchronization of subordinate organizations
- Benefits resulting from increased connectivity

Department of Defense Command and Control Research Program
www.dodccrp.org
Asst. Secy. of Defense for Networks and Information Integration
Strategic Information

“We must view information as a strategic asset. Timely, accurate, and trusted information lies at the heart of network-centric operations.”

– John G. Grimes, DoD CIO
Next Generation Air Traffic Control

FAA says the shift from radar to GPS, from analog voice to digital data communications, and from old to new on-board and control center computers and displays will:

- Increase safety
- Reduce congestion and delays
- Improve the efficiency of airline operations
- Reduce fuel consumption and emissions
- Increase the capacity of the National Airspace
Ditmeyer’s Vision of “Network Centric Railway Operations”

Use integrated digital data communications, GPS positioning, sensors, computers, and displays on railways to:

- Improve both safety and security
- Raise effective capacity
- Improve asset utilization
- Improve running time and running time reliability
- Improve customer satisfaction
- Measure and control costs
- Reduce energy consumption and emissions
- Increase economic viability and profits
- “Manage the unexpected”
What Railway Managers Need to Know:

- Where mobile assets* were (for billing, payments, and analysis)
- Where mobile assets are and what they are doing, in real time
- Real-time status of mobile assets (i.e., Are they serviceworthy?)
- Real-time status of fixed assets** (i.e., Is the infrastructure trainworthy?)
- Where mobile assets will be at time $t_1$ in the future
- Where mobile assets need to be at time $t_2$ in the future
- How best to get the mobile assets from where they are and will be to where they need to be
- That the correct instructions are being conveyed to the right crews and vehicles, and that the instructions are being complied with

* Trains and train crews, locomotives, cars, EOTDs, maintenance equipment and personnel
** Track, switches, bridges, tunnels, yards, terminals
Recommendation #1

- Implement integrated systems, rather than free-standing systems
  - Integrate PTC with precision dispatching, AEI, work order reporting systems, locomotive health monitoring systems, and others
  - Digital data communications channels have substantial capacity – much greater than analog voice channels – and permit discretely addressed messages to single or multiple recipients
Recommendation #2

- Study information flows
  - Provide each person with *all* the information he/she needs to do his/her job
  - Provide each person with *only* the information he/she needs to do his/her job
  - Make sure the information is intelligible
  - Decide which information to “push to” users and which to have “pulled by” users
  - Consult the users
Recommendation #3

- Security and information assurance must be constant considerations
  - Data regarding trains, freight cars, crews, and shipments must be kept confidential
  - Authentication of data will insure that the content is genuine, unaltered, and complete
  - Unwarranted extraction of information from communications network must be prevented
  - Encrypt data to keep it out of wrong hands
Recommendation #4

Backup and redundancy are important

- Fault-tolerant system architecture
- Dual-redundant components
- Integrated architecture provides checks and balances to limit the impact and propagation of human errors
Recommendation #5

Don’t underestimate the inertia of legacy systems (i.e., signal systems)

- PTC offers a new paradigm
- Digital data link and GPS provide real-time information
- Operating rules must be changed; don’t saddle PTC with old rules that were based on delayed information flows
- Legacy systems must be written off as “sunk costs”
Recommendation #6

Technological change will affect companies in unforeseen ways; choices have to be made in intellectual capital, financial capital, and process

- Additional staff with proper skills (e.g., expertise in systems design and integration, program management, avionics) will need to be trained and hired
- Reallocation of capital needed to implement PTC and net-centric systems implementation
- PTC and net-centric systems, if implemented properly, will generate capital for investment in infrastructure and rolling stock
- Budgeting processes must be modernized; “soft dollar” benefits included, not just “hard”
- Don’t optimize subsystems - optimize the total system
Recommendation #7

Be aware that net-centric operations will affect an organization’s culture

- Only with changes in the way an organization does business can it fully leverage the power of information
- Information flows will be different; some in the organization will feel threatened
- Telecommunications and train control staffs need extremely close working relationship
Recommendation #8

Make sure the implementation team represents *all* affected departments

- Team members must coordinate project activities with their home departments
- Team members must coordinate project activities with their counterparts at their system integrator, suppliers, and contractors
- Team members must coordinate project activities with each other
- Do not try to minimize the size of the team
- A committee is not a team
Recommendation #9

- Recognize that net-centric operations are not a panacea; they may encourage micromanagement
  - Use information to improve performance of the railway, not to monitor the performance of individuals.
  - Net-centric systems enable both “reach back” and “reach forward” for information. There must be a balance between centralized planning and local execution.
Recommendation #10

Choose top leaders well

- “Leaders Count”
- The top leaders must understand the technology, establish the proper environment for its deployment, and provide proper incentives
- The top leaders must elevate the project implementation team in the hierarchy and talk with the team regularly
Recommendation #11

- The implementation strategy must be clear and unambiguous
  - Top leadership and project implementation team must jointly set strategy
  - Is the organization going to implement a “safety-only” system, or a system that encompasses safety, efficiency, and service?
  - Is it too late to change strategy?
Recommendation #12

Communicating is important!

- The implementation strategy must be communicated throughout the railroad to all departments
- Suppliers and customers need to be informed
- Communicate early and often with the unions; they are the folks who will install, operate, and maintain the systems. They are key to a successful implementation.
Recommendation #13

- Maintain realistic expectations, and be patient
  - Net-centric systems are governed by Metcalfe’s Law, which asserts that the power of a network is proportional to the square of the number of nodes in the network
  - Metcalfe’s Law is really about potential gains; there is no guarantee that simply hooking things up will make the results better
  - Thinking, planning, and organizing are essential
“Net-enabled operations, while clearly complex, can actually be described quite simply. It is all about ensuring timely and accurate information gets where it’s needed, when it’s needed, and to those who need it most.”

– John G. Grimes, DoD CIO
A new era is upon us
Railways have the opportunity to maximize the benefits from the investments they are required to make in PTC
Network-centric operations are the way of the future in many different organizations (e.g., military, aviation, parcel delivery services, emergency responders)
Learn from successes and failures of other users
Improved railway safety, security, efficiency, and profitability are all achievable with proper implementation of PTC and net-centric operations
Questions?

Steven R. Ditmeyer
Adjunct Professor
Railway Management Program
Michigan State University
www.raileducation.com

srditmeyer@raileducation.com; srdit@aol.com
How PTC Permits More Efficient Train Meets

Accurate projections of train location reveal opportunities to reduce meet/pass delays.
How PTC Permits More Efficient Train Passes

The ability to operate with short headways can reduce meet/pass delays.

![Diagram showing train passes with greater and less headway](image)
Locomotive Cab Displays
Locomotive Cab Displays

4011 LOW OIL PRESSURE
HOT WHEEL RIGHT SIDE AXLE 63

ONE ISSUED TRACK WARRANT IS 121.

87 LOADS  24 EMPTIES  9200 TONS  8150 FEET

NEXT WORK AT JUNCTION 12382
Locomotive Cab Displays
# Locomotive Cab Displays

<table>
<thead>
<tr>
<th>SEQ</th>
<th>NUMBER</th>
<th>L/E</th>
<th>KIND</th>
<th>TONS</th>
<th>DESTN JCT</th>
<th>SPECIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6802</td>
<td>SD-40-2</td>
<td>120</td>
<td></td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6905</td>
<td>SD-40-2</td>
<td>120</td>
<td></td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4011</td>
<td>B30-7A</td>
<td>120</td>
<td></td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>7822</td>
<td>SD-40-2</td>
<td>120</td>
<td></td>
<td>02201</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>TTX974548</td>
<td>L</td>
<td>FUB/050</td>
<td>055</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>TTX990456</td>
<td>L</td>
<td>FUB/050</td>
<td>067</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>159664</td>
<td>FT8/050</td>
<td>034</td>
<td></td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>TTX252793</td>
<td>L</td>
<td>FT8/080</td>
<td>087</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>TTX991422</td>
<td>L</td>
<td>FT8/080</td>
<td>084</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>TTX156511</td>
<td>L</td>
<td>FT8/080</td>
<td>078</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>TTX154138</td>
<td>L</td>
<td>FT8/080</td>
<td>089</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>FEC2848</td>
<td>L</td>
<td>FUB/050</td>
<td>078</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>TTX253811</td>
<td>L</td>
<td>FUB/050</td>
<td>067</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>TTX102312</td>
<td>L</td>
<td>FUB/050</td>
<td>085</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>WP8898</td>
<td>L</td>
<td>FUB/050</td>
<td>084</td>
<td>16001</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>TTX251770</td>
<td>L</td>
<td>FT8/100</td>
<td>074</td>
<td>12381</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>TTX250312</td>
<td>L</td>
<td>FT8/080</td>
<td>084</td>
<td>12381</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>TTX604629</td>
<td>L</td>
<td>FT8/050</td>
<td>056</td>
<td>12381</td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>STTX911855</td>
<td>L</td>
<td>FT8/050</td>
<td>074</td>
<td>12381</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>TTX991425</td>
<td>L</td>
<td>FT8/050</td>
<td>097</td>
<td>12381</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>TTX991425</td>
<td>L</td>
<td>FT8/050</td>
<td>090</td>
<td>12381</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>TTX156101</td>
<td>L</td>
<td>FT8/080</td>
<td>074</td>
<td>16021</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>TTX251793</td>
<td>L</td>
<td>FT8/080</td>
<td>025</td>
<td>16021</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>TTX996648</td>
<td>L</td>
<td>FT8/080</td>
<td>088</td>
<td>60016</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>WP7643</td>
<td>L</td>
<td>FT8/100</td>
<td>024</td>
<td>60016</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>BN221057</td>
<td>L</td>
<td>BS/050</td>
<td>057</td>
<td>60016</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>BN317105</td>
<td>L</td>
<td>BS/060</td>
<td>067</td>
<td>60016</td>
<td></td>
</tr>
</tbody>
</table>