MCX

Member Communication Experience

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[1] Gordon E. Moore "Cramming more components onto integrated circuits", 1965
[2] Karl Rupp – "40 years of Microprocessor Trend Data"
[3] https://ourworldindata.org/technological-progress

chain issues, spikes in the costs of construction materials, labor shortages across all trades, and the
[illegible]

Figure1 – Moore’s Law –

“Familiarity Bias” and “Proximity Bias”

Innate biases, coupled with years of practice, may

To mitigate these delays, the project team decided to overlap construction with dynamic testing. This put enormous pressure on the delivery team. The testing could not be conducted efficiently, however, as it was discovered that "the train and signaling software had not been developed to the required level."[8]

Due to software development issues, "few meaningful results could be acquired," and challenges with completing the testing effort "took any spare time and space from construction workers on-site,"[9] causing further delays and cost increases.

It is important to note that, even if the project team had delivered the infrastructure scope on time, the underdeveloped and delayed software would have preventDuene (t)7fntrewded suld nde41.7 d the ceaved (d.7 (h)

allowing for automated train control operations and "communications" between the various components of the whole system.

Figure 3 – Schematic representation of PTC system's major components and interconnections.[13]

As with the Crossrail and Electrical Substation projects, PTC developments on railway systems in the U.S. have experienced multiple delays with similar root causes.

In its 2018 report,[14] produced two years before the final PTC completion deadline, the U.S. Government Accountability Office (GAO) cited software issues as one of its concerns, but not the primary one. It is important to note that, in 2018, many railroads were at the early stages of their PTC testing program and had only begun to uncover the extent of software issues at this converging point. According to the report, "nine passenger railroads reported encountering challenges related to maturity of the PTC software systems, such as working through software bugs or defects during testing."

A year later, the updated GAO report[15] paints a different picture: "31 of 37 railroads said software issues were a major or moderate challenge."

understandably wanted to utilize the newest available technologies. However, as the software was constantly evolving, the potential for scope creep increased and the appropriate management of the software development became cumbersome.

Moreover, as opposed to traditional linear planning of construction scope, the software development process is, by its nature, cyclical and non-linear. Each functionality needs to be developed, tested, debugged, and retested. This process repeats at subsystem and system levels until software is stable and functional.

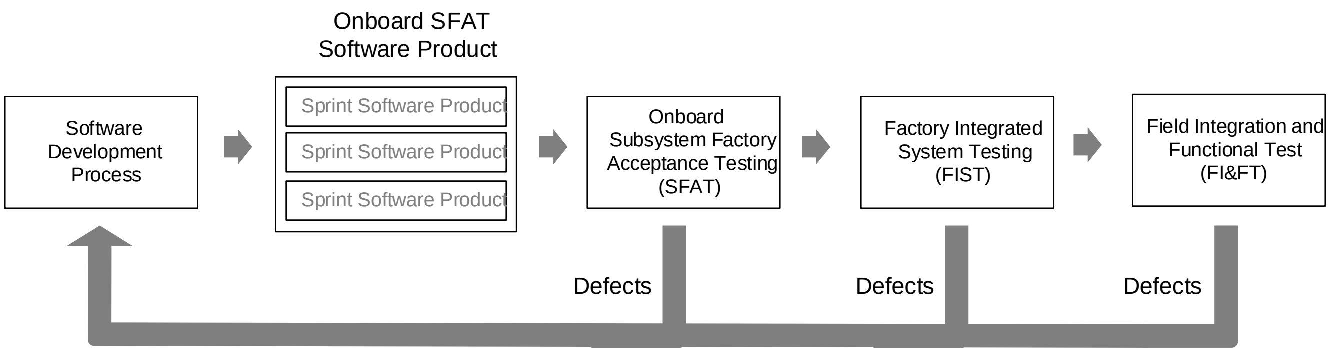

Figure 4 – Cyclical process of onboard software development and testing process on a PTC project. (Illustration by Author)

For many PTC projects, in fact, the completion of software development has turned out to be a "moving target." It has become apparent that without clearly defined functionalities for design freeze and a well-developed change procedure that takes into account differences between agile and traditional project management and planning methods, software development can quickly become a significant issue.

In the interviews conducted for the GAO 2019 report, some railroad representatives stated that "they had no control over this process [software development], as they must rely on the vendor to provide reliable software."[16] The report further suggests that "Representatives from this railroad also noted that resolving software issues is often not entirely within a railroad's control due to the need for vendor support, in contrast to some earlier challenges leading up to the 2018 deadline, where, for example, the railroad itself had more control as it was installing equipment and could more clearly track progress."[17]

Case Study - SEPTA's On-Time PTC Technology Implementation

The Southeastern Pennsylvania Transportation Authority (SEPTA) was one of a handful of agencies throughout the U.S. to operate all of its trains with PTC ahead of the federal deadline. All SEPTA regional rail trains, operating in both SEPTA and AMTRAK territory, were PTC-compliant as of May 1, 2017.[18] SEPTA, one of the nation's largest transit agencies, serves Philadelphia and its surrounding counties, with regional rail service extending as far north as Trenton, New Jersey, and as far south as Newark, Delaware. SEPTA also is one of only two U.S. transit agencies to operate all five types of on-land transit

16 GAO-19-693T - Testimony Before the Committee on Commerce, Science, and Transportation, U.S. Senate – Positive Train Control – July 31, 2019
17 GAO-19-693T - Testimony Before the Committee on Commerce, Science, and Transportation, U.S. Senate – Positive Train Control – July 31, 2019
18 https://www.hka.com/positive-train-control/

vehicles: regional commuter trains, heavy rapid transit (subway/elevated) trains, light rail vehicles (trolleys), trolleybuses, and motorbuses.[19]

Merging new PTC technology with legacy systems can be difficult, said Stephen J. Malaszecki, executive vice president at Envision Consultants, Ltd., a subcontractor on PTC projects in Philadelphia, New York and New Jersey. “Getting new technology to fit—and work well—with existing hardware isn’t easy, and it requires extensive testing to get it right and to pull everything together,” he said.

Retrofits become even more challenging if rail track is shared by more than one railroad. “When more than one agency is involved, there are always issues, especially when you’re dealing with track that’s used by both freight and passenger rail, for example,” said Malaszecki, who has nearly 40 years of experience in scheduling and project controls.

Ideally, systems testing should occur at intervals throughout a project—rather than at the end—and that testing should be allocated ample time in the schedule, Malaszecki said.

“When developing a schedule that includes equipment or systems testing, it is essential to review the detail of the project and determine the earliest time at which you can begin testing. Most projects place just one or two activities at the end of the schedule to reflect testing, but there are many instances where testing can begin much earlier,” he explained. “On a bus rapid transit project, for example, which usually involves miles of construction as stations are built consecutively, testing can begin on a station-to-station basis and proceed as construction moves forward. Then, final systems testing occurs when the construction is complete.

“When testing is scheduled and conducted incrementally, you can fix problems as they arise. If there’s an issue with the first test, for example, and there’s something in the system that is causing the discrepancy, you can fix it and then proceed, lessons learned, to the next action,” Malaszecki continued.

Planning and communication are essential to that plan, Malaszecki added. "A highly detailed, consistently applied communication plan that is tied to the project schedule and includes each member of the project team — internal staff, outside consultants, contractors, subcontractors, and manufacturers — is extremely important," he said.

Focus on Both Systems *and* Structures

In addition to implementing education and training to elevate understanding of technology and help change mindsets, there are leading practices that can help prevent software development issues from derailing infrastructure projects:

> Consistent, Interdisciplinary Planning and Scheduling. It often seems as if software developers and construction professionals speak different languages. This becomes apparent in discussions about scheduling concepts. "Gannt Charts" and "finish to start logic ties" might not mean much to a software developer, just as "product roadmaps" or "blockers" may not sound familiar to a construction scheduler. However, the reality is that some of the concepts are very similar. In fact, the terms above mean more or less the same thing.

Today, integrated, digital deliverables can be more important for end-users and owners than a "structure." To address related risks, construction management's focus must shift from traditional civil, structural, and mechanical scopes to a broader, all-encompassing delivery of functioning systems as part of smart infrastructure. "Sticks and bricks" should no longer be the sole focus of infrastructure upgrades. Rather, all system components should be treated as crucial to o(t)3.(e)2.8 (d)e285 0 (i)-7 (n)-0.6 (d5d)2.4 059tna3.7