Walking the Model: The Smart Mobile Field Engineer (Keynote)

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ABSTRACT
Walking the Model (WtM) is a concept that aims to promote the practice of practitioners and crews by providing on-the-job interaction between the system model of the business and the physical world. Among various implementations of this idea, WtM provides mobile field engineers with the ability to view, update and simulate by asking what-if questions while in the field. In this keynote speech, I present the notion and features of walking the model and show how WtM changes the way we perceive of different practices for both actual practice and learning processes.

Categories and Subject Descriptors
D.2.2 [**Design Tools and Techniques**]: User interfaces; H.5.3 [Group and Organization Interfaces]: Theory and models.

General Terms
Performance, Design, Human Factors.

Keywords
Walking the model, on-the-job simulation-based interaction.

1. WALKING THE MODEL CONCEPT
Walking the Model is a concept that aims to promote the practice of practitioners and crews by providing on-the-job interaction between the system model of the business and the physical world.

Any industry concerning field service employs a business infrastructure that is composed of some combination of business assets, machinery (e.g., sensors, actuators), data, and the relationship among them. Such infrastructure can be described at different levels of abstraction – what we call the *System Model,* or shortly, the Model. For example, in Energy companies, the power grid may be referred to as a core part of the model; or in Smart Cities, the public illumination grid may be referred to as model part, etc. Regardless of the particular domain, the model itself is usually maintained using some computerized means that are in the veins of the business operations. Hence, having a faithful representation of the actual situations in the real world at all times, as depicted by the model, is critical to operational efficiency.

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Walking-The-Model allows putting the relevant model in the center, aiming to cut losses by facilitating more efficient maintenance of the model. The current reality is that it is cumbersome to keep organizational information systems up to date in the corresponding operational systems. Our approach focusing on the interaction with the model implies that various operations performed by independent practitioners are all synchronized with the model as the central point of truth. Thus, model accuracy is kept at all times, and indirectly, the model itself becomes centric to the synchronization of all other business operations. Using the model as the baseline, all other aspects pertaining to the business supply chain and operations can be put in concert with it e.g., work order prioritization, asset management, etc.

WtM includes four fundamental interaction operation types that can be performed by crewmembers as well as by the system operations:

The ***View*** category of operations allows practitioners to inquire about the characteristics of a certain model component in real-time while engaging with the corresponding model component in the physical world.

The ***Record*** category of operations enables practitioners to document the knowledge gathered along physical encounters with a certain model component, while in the field in a timely manner. Such knowledge is gathered by associating model components with various means such as photos, textual annotations, and note scans.

The ***Validate*** category of operations provides practitioners with the ability to test different "what-if" scenarios that refer to a certain physical component, and examine, on the model itself, the possible outcomes of the alternative actions prior to their actual pursuing.

The ***Update*** category of operations allows practitioners to modify existing knowledge properties already recorded about model components in the system based on encounters with these components in the physical world, while conforming to the approval and related governance mechanisms associated with such modifications.

2. VALIDATING THE WTM CONCEPT
With an aim to validate the WtM concept, we developed a mobile application to support the synchronization of field engineers' actions in the Energy field service. The app provides the use of the mobile device location service (e.g., GPS), and QR-code markings of the various components in the physical world.

2.1 Accuracy of the Energy Distribution Grid

Within the domain of Energy and Utilities, as it may seem almost obvious, quality of service is a key to the success of the domain suppliers. Maintaining consistent and valid view of operations is crucial both for business efficiency and for end user satisfaction. One such view is the Connectivity model, which is a model representing the various electricity power sources, distributors, transformers, consumers, and their inter-connecting power lines, all comprising the electricity grid. The Connectivity model is the main working tool according to which all maintenance and restoration activities are derived. Currently there is insufficient availability of technical means that would facilitate and ensure the faithfulness and timely representation of the real system status, potentially leading to excessive downtime and monetary losses.

WtM application aims at mitigating the burden of consciously maintaining model accuracy, bridging between the physical and the virtual model views via a designated mobile application that is put in the hands of field engineers to seamlessly keep track of their day-to-day actions. Granting the ability for the entire ecosystem to work with a reliable connectivity model can dramatically boost the efficiency of the entire value chain.

Following is one of the representative use cases that were developed based on close familiarity with processes in Energy services.

2.2 Field Inspection and Work Initiation

This use case involves field crews performing actual field inspection work. This work is typically planned and requires a crew to visit a specific set of components on the network in order to validate the components, record specific test results as requested, validate information already known about the components and provide any further observations. Today this is performed with limited context of the component in its relationship to the power network, its geospatial relationship and any in-field or back-office real-time analytics. Table 1 describes the details including WtM synthesis that is marked in each step.

2.3 Using the WtM Application

The WtM application aims to support the fundamental interaction operations for the field engineers to perform their work. Figure 1 shows the simulation view of the WtM mobile app in which the field crew can ask what-if question whether replacing the malfunctioned transformer with another one provides a valid model. This should be checked against domain specific analytics.

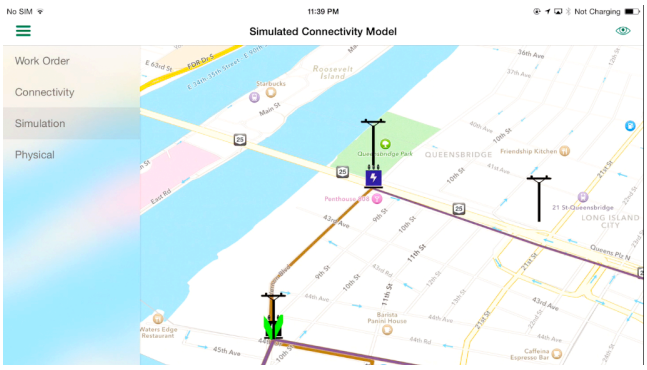

Figure 1: WtM simulation view

Table 1: Field inspection using WtM

Actor Name	*Description of Step*
Field Crew	The crew starts their workday. WtM automatically downloads all their planned work and present a geospatial view of the locations of the work, the power network and its current known state, locations of emergency services and locations of other crews. The driving directions from their current location to the first work location are shown. [VIEW]
SYSTEM	The field crew arrives at the first location. The device automatically indicates the location. If in connected mode, WtM constantly provides location information back to host systems for operations. [UPDATE]
Field Crew	The field crew acknowledges that they are going to proceed with their work. [UPDATE]
SYSTEM	The field crew is going to perform a pole inspection. All the information regarding the pole such as type (type, date installed, prior inspection details, etc.) are provided to the crew in both textual dialogs in a spatial view. The data from relevant sensors e.g. real time reading from devices such as transformers that are attached to the pole, is shown too. [UPDATE]
Field Crew	The crew repositions the location of the pole based on the current location of the mobile device. This immediately changes the location of the pole in the model view. [UPDATE]
Field Crew	The crew notes that the pole is encumbered by vegetation; they take a photo of the pole and the information is saved using WtM. [RECORD]
Field Crew	The crew performs a pole test and enters results into the appropriate work order. [UPDATE]
Advanced Analytics	Based on the result of the pole test, WtM app performs some analytics based on prior tests and current test results and flags to the crew member that the pole requires immediate replacement. [VALIDATE]
Field Crew	The crew acknowledges the pole defect, signals that the work must be scheduled. [UPDATE]
SYSTEM	WtM app completes the work, sends updates and work request to back end systems, shows the pole status of replacement pending. [VIEW]

2.4 Learning Processes

The WtM concept and mobile app enhance field engineering by providing on-the-job mechanisms for learning and improving the practice. Specifically, using simulation to ask what-if questions thus consulting with a simulator before performing a certain action while in the field, provides on-line learning and increases the confidence and professionalism of practitioners.

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