Adaptive Service: Digital Service Platform and the Service Crowd Community

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Schindler AG has been one of the world's leading producers of elevators, escalators, and moving walkways for nearly 150 years. Vertical personal transportation is, simply put, one of the crucial innovations that have made our modern cities possible—life without them is practically unimaginable. Yet as our signature products have become ubiquitous in over 140 countries, the maintenance of elevators and escalators has seen revolutionary changes in recent years.

The Internet of Things (IoT) and smart technologies are enabling new ways of monitoring and managing objects in the physical world, while massive streams of data are allowing for better decision-making—often mediated by machines (Turber, vom Brocke, Gassmann, & Fleisch, 2014). The analytical capacity of these connected and monitoring systems has evolved to the point that they can even make some maintenance decisions autonomously. They've changed maintenance from a rigid, time-based practice into a unit-specific approach based on well-informed decisions from unit information.

IoT-enabled systems are a fast-growing industry. McKinsey estimates that by 2025, IoT will have a potential total economic impact of as much as $11.1 trillion per year. In fact, IoT will be the biggest source of value of all disruptive technologies, ahead of mobile Internet, knowledge-work automation, cloud computing, and advanced robotics (Manyika et al., 2015). With this rapid pace of change, the role of human actors in the maintenance process of the future is more open, debatable, and undefined than ever before. Are these developments making the human factor involved in these analyses and in general maintenance more and more irrelevant? Will a time come in which we can dispense with the human factor altogether? So many of these questions can be boiled down to the following: How much knowledge resides in the machine, and how much in the humans who maintain it?

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At Schindler, this question is more important than ever in guiding our drive to innovate maintenance. We're proposing a balanced approach to future digitalization: adaptive service. This novel approach is predicated on the idea that despite all the advances in machine learning, elevator and escalator service and maintenance, full digitalization is not able to cope with the complexity and change of the elevator and escalator service business by itself. Instead, it will be human-centric and collaborative to master complexity, create new opportunities, and continuously improve and innovate. It synthesizes the digital service platform with the service crowd community in a complementary manner.

This article will establish the concept of adaptive service based on the review of service maintenance methodologies, the path to full digitalization and main challenges, the distinctive strengths of the human factor, and how it can overcome the identified challenges. Finally, the concept of adaptive service will be detailed based on examples established at Schindler.

1 Service Maintenance Methodologies

With the emergence of sensor and IoT technologies, maintenance teams have gained the ability to monitor the health of individual components and make informed, data-based decisions about whether and by when they should be maintained, replaced, or repaired. The availability of this data has, in turn, given rise to different maintenance methodologies that take advantage of that data. Schindler refers to this network of sensor data for elevator and escalator installations as the Internet of Elevators and Escalators (IoEE), a specific version of the IoT.

The increasing ubiquity of sensor technology and connected devices has made it possible to move beyond planned maintenance, which was associated with significant material and personnel costs, general inefficiency, and low uptime. Under condition-based maintenance, the trigger for maintenance is no longer a predefined schedule, but the asset's actual condition monitored by sensors (Bellias, 2017).

In the elevator and escalator industry, the country or regionally specific norms are partly given strict boundary conditions, including the time and the tasks to be done by service technicians on-site. These norms are providing the framework in which the new maintenance planning can take place. Generally, we can observe that these boundary conditions are now often in discussion based on positive experiences in countries with fewer restrictions on planned maintenance. The IoEE-connected units make it possible to increase the total amount of checks with a shift toward more remote checks—partly 24/7—so assuring the same or higher safety levels and uptime.

This puts condition-based maintenance center stage. As Bellias (2017) explains, "with the automation of many industries and the explosion of computers and sensors, condition-based maintenance has become machine-led. Sensors built into equipment provide real-time readings to centralized systems, that help maintenance teams maintain equipment before problems occur. [. . .] Most companies have either adopted or are working towards implementing rigorous condition-based maintenance programs to reduce cost while improving uptime."

As more assets become connected and computers gain the ability to use the generated data to not only display the current condition of an asset but rather to take an active role in decision-making, new forms of preventative maintenance are on the rise.

Following Bellias (2017), "predictive maintenance takes condition-based maintenance one step further. Once data is [provided by equipment in (near) real time], advanced analytics are used to identify asset reliability risks that could impact business operations." Simply put, where condition-based maintenance makes it possible for technicians to know if maintenance needs to be performed, predictive maintenance attempts to inform technicians of when maintenance will need to be performed.

Hence, by "applying machine learning and analytics to operational data generated by critical assets to gain a better understanding of asset performance, companies can act on these insights as part of a continuous improvement process. In addition, data beyond machines can be used for predictions, such as weather data, information from other systems beyond traditional enterprise asset management systems, and any other data sources that may be valuable" (Bellias, 2017). While predictive maintenance uses IoEE-enabled assets and the data that they provide to tell technicians when equipment is likely to fail, it does not definitively make the decision to conduct maintenance. It's often difficult to prove that a machine would have been broken when it was fixed already. Therefore, the business model that's often chosen with predictive maintenance is performance-based, so there's a single decision-maker for maintenance cost and performance. In this way, the decision-making associated with predictive maintenance is still based on human decisions.

Since prescriptive maintenance doesn't just analyze but also recommends suitable courses of action, it constitutes a paradigm shift that's making it possible to move from a prediction of when an event happens to a respective preparation of what has to be done. Prescriptive maintenance leverages advanced software to pattern identification points to explicitly diagnose root cause issues and then indicate precise and timely actions to promptly change the outcome. Analytic capacities are the foundation of prescriptive maintenance, and these "cognitive" maintenance systems are at the intersection of big data, analytics, machine learning, and artificial intelligence. This is currently considered to be the future of the industry by many companies.

Prescriptive maintenance requires a variety of asset management and maintenance systems to be well integrated into the overall system (Bellias, 2017). For instance, "a predictive maintenance solution might recommend that a piece of equipment [be repaired or replaced] based on an analysis of vibration and temperature readings, but a prescriptive system would [initiate] a work order to field technicians based on this information, including what has to be done and oversee the entire maintenance workflow" (Bellias, 2017). The role of a human would then be as a receiver of tasks that just has to strictly follow what's prescribed. Yet, the degree to which humans will participate in the maintenance decisions is still a matter of a great deal of research and debate.

2 The Journey to Full Digitalization

Full digitalization in maintenance can be understood as a maintenance system that automatically detects and actions anomalies using IoT-enabled connected devices—either performed by the installation itself or an AGV (automated guided vehicle) or a robot.

Technically speaking, the development of a fully digitalized elevator and escalator maintenance system is entirely possible. However, the questions of when it will be possible, how it can be developed, and the cost of doing so remain unanswered. With the current state of the industry, the development of such a system would surely take years and come at a great cost. Yet full digitalization is not just a question of task coverage, technical know-how, and ability; it must also be viewed from an economic perspective.

Based on the existing service methodologies, the focus was to identify when a failure happens and then go on-site shortly beforehand to keep the uptime of the equipment as high as possible. Prescriptive methodology further optimized this approach. These methodologies have been built in industries where access to the equipment and/or downtime of the equipment is most important. In the elevator and escalator industry, this is also true for the so-called callbacks or when a unit is stopped. Yet the time and cost needed to access a unit in a safe manner are relatively high. Performing a task early when on-site makes more economical sense than waiting for the latest possible date. Therefore, the network optimization of all resources has an essential role in service business optimization and needs to be considered in task coverage.

Costs still limit the full automation of elevator and escalator maintenance. These costs include development and implementation and the necessary physical space and infrastructure in future and pre-existing units, as well as the decreasing of overall costs of employing humans to do the same task. As such, the execution of on-site maintenance is likely to remain human-based until there's more incentive to resolve the cost-prohibitive status of a fully automated maintenance unit. The extent to which automated or robotic maintenance systems could aid or replace the humans in the elevator shaft or under the escalator is still a subject of discussion and research in the industry, as are its inherent advantages.

The complexity of using mixed systems and various models, which is not uncommon in many buildings today, should not be underestimated when considering the implementation of a fully digitalized system. With so many manufacturers around the world having manufactured a plethora of different models over decades or even a century, elevator and escalator systems are hardly consistent. Often this kind of complexity in the field becomes obvious when the service technician arrives on-site and needs to figure out what to do and how. Often the most appropriate maintenance measures are based on the experience and knowledge that has been gained over years of work and handed down to the next generation of service technicians (e.g., when fixing topics jointly on-site). A fully digital system with the same knowledge and ability to cope requires having a comprehensive and high-quality database. Collecting all this data and ensuring its quality is a big challenge.

This adds immense complexity to the digitalization process and creates a significant obstacle for the creation of fully digitalized systems. While AI and ML can generate data sets for these unique mixed installations and use them correctly over time, those data sets will only be relevant for the system itself or for an identical mixed system with the same models and physical parameters. That means that fully automating mixed systems would largely have to be done on a case-by-case basis. This drastically increases the effort to fully digitalize while at the same time decreasing the incentive to do so.

Elevators and escalators are means of human transport and are therefore affected by their behavior. Blocking doors, for example, instead of using the buttons, have a negative effect on the status of doors, potentially leading to a breakdown. Prediction is difficult for a specific unit and can be done in more of a general way, like for big events and the respective units in this area. With the current COVID-19 challenge, passenger behavior and usage patterns have changed significantly, also driven by new ways of interaction with the elevator via mobile phone apps or touchless sensors. Predictions for units have their limits due to a lack of historical data.

As more and more devices are connected to the Internet of Things, particularly close attention must be paid to security and privacy. On a seemingly monthly basis, we're treated to stories of spectacular hacks and security breaches at a wide range of companies with all kinds of data and solutions. Usually, it's the loss of personal or financial data or politically sensitive materials. But connectivity and data associated with mobility solutions add a new dimension with regard to security. The consequences for the industry for security breaches in fully digitalized, AI-driven escalators and elevators could be severe. Going forward, manufacturers and service providers will need to invest heavily in cybersecurity in order to initiate dedicated programs and organizational units that ensure total data security. All communication is encrypted using the highest security standards, and just the minimum required data is collected (Gupta & Schneider, 2018). Data privacy is of the strongest concern for Schindler and is an area in which the company is seeking collaboration with data and security experts in academic institutions.

3 The Human Factor: Experience and Creativity

The advances in prescriptive maintenance can only be applied reliably with enough relevant data. Without it, the systems will fail to truly understand all the relevant patterns. That's because machines will only make decisions based on the data they have. They lack the experience and creativity to solve unforeseen or unique maintenance issues because they can only derive this data from previous experiences. These are the gaps that humans can close in tandem with the digital platform.

Schindler embraces the need for human involvement while using technology to optimize their role to the greatest possible extent. Knowledge is available from different sources, such as the unit documentation, but also from the minds of human service technicians. The internal saying goes: "When Schindler knows what Schindler knows." The limitation here is often language-driven as the technical proficiency is typically in the local language.

The role of human creativity is not just important for individual maintenance tasks but also crucial for analyzing and improving the overall maintenance process. While smart technologies employ AI and ML to predict and prescribe the replacement of components, they can't interpret data to suggest improvements to the overall system beyond those singular measures. Only human technicians with access to the experience and knowledge of other, more versed human technicians can examine the situation and make appropriate and creative decisions to further streamline the entire process. That's why our company is actively training data scientists for special functions in the Technical Operations Center. Only when the technicians master analysis and problem-solving can a genuinely productive network be created.

Schindler believes that streamlining the availability and accessibility of human knowledge and experience will lead to the next level in maintenance. Innovation is a crucial factor for success for staying competitive while optimizing and rethinking processes. It also offers new services to our customers. These new ideas are based on creative thinking done by humans. As an example, within 3 months, a total of eight new products have been developed to fight the COVID-19 pandemic. It includes the award-winning UV light for escalators that ensures clean handrails. To achieve this, Schindler leveraged the global team in all countries.

The predictive and prescriptive maintenance approaches and technologies that have been developed over the past decade remain a tool of the humans in the process. Keeping in mind the obstacles to the full digitalization of elevators and escalators described earlier, Schindler argues that we should accept the current human-led approach to maintenance and develop and plan solutions based on it for the foreseeable future.

4 The Service Crowd Platform: Adaptive Service

Developed by Schindler, adaptive service is a unique way of performing elevator and escalator maintenance that successfully fuses elements of predictive and prescriptive maintenance integrated with a dynamic planner complementing the service platform while emphasizing the human factor in the process by high usability and collaboration that enables the crowd to collaborate. Together, adaptive service is a flexible and continuously learning service crowd platform. As such, it combines the latest AI-driven digital technologies and processes with human expertise to maintain a unit according to its one-of-a-kind condition. It has the personal and technical ability to immediately rearrange processes, methodologies, and capabilities to maintain equipment according to its current requirements. In other words, adaptive service does not require elevator and escalator units to be so similar and then improves the capacity to work with mixed units.

Starting from the Schindler Ahead platform, the main areas to work toward this vision are:

1. Complement the service platform by feeding the gained insights and recommendations with dynamic resource planning, including material and people to bring insights to concrete actions for the field integrated into daily schedules.
2. Standardize the user interfaces (HMI) of the service platform and the people in the field—internal and external—to limit user training need of the tool(s), reaching high user acceptance.
3. Globally connect the crowd—all users of the service platform—by respective multilingual collaboration tools and knowledge documentation.

Adaptive service makes use of the powerful IoT-platform Schindler Ahead to analyze cloud-based data in real time, so that potential issues can be anticipated and resolved before they occur, moving the methodology beyond predictive maintenance. It provides operators and building managers with real-time status reports and tailored apps that enable them to check on operational performance and commercial data to better manage their equipment portfolio.

In order to create a maintenance methodology that best supports the human technicians who perform the maintenance, adaptive service works as a closed-loop system. In a reciprocal cycle, information is collected, analyzed, and translated into the precise instructions needed for the human technicians to take the appropriate corrective steps. Incoming messages are automatically evaluated within seconds and assigned to service technicians for analysis and decision-making.

Adaptive service offers asset managers and technicians the benefits of both worlds: human expertise and advanced technology. Adaptive service is always provided on the basis that the two work in symbiosis; humans are supported by the technology to complete maintenance tasks and, in turn, contribute their knowledge and learned experience to managing the asset and the industry as a whole, allowing for the development of better units and the better maintenance thereof (Fig. 1).

In the closed-loop adaptive service maintenance approach, elevators and escalators relate to the Internet of Elevators and Escalators (IoEE) using Schindler-developed Ahead Connectivity. This enables any type of unit to be monitored in status and performance by the Remote Monitoring Platform, which transforms data into meaningful insights and information for service technicians, technical operators, and customers.

Adaptive service is specifically designed and implemented to support the human element in the maintenance process. Here's a short overview of some of the most important ones:

Ahead Remote Monitoring Platform: Analytic platform turning data into actionable insights, which improves response time, predictions, and information overviews.

Technical Operations Center: Field support by experts using the Remote Monitoring Platform and Analytics. It enables improved uptime and improved first-time fix rate.

Field Tool Suite: Includes tools such as FieldLink, FieldBoard, FieldSupport tools and modern digital toolset for Schindler Service Technician and Service Leader

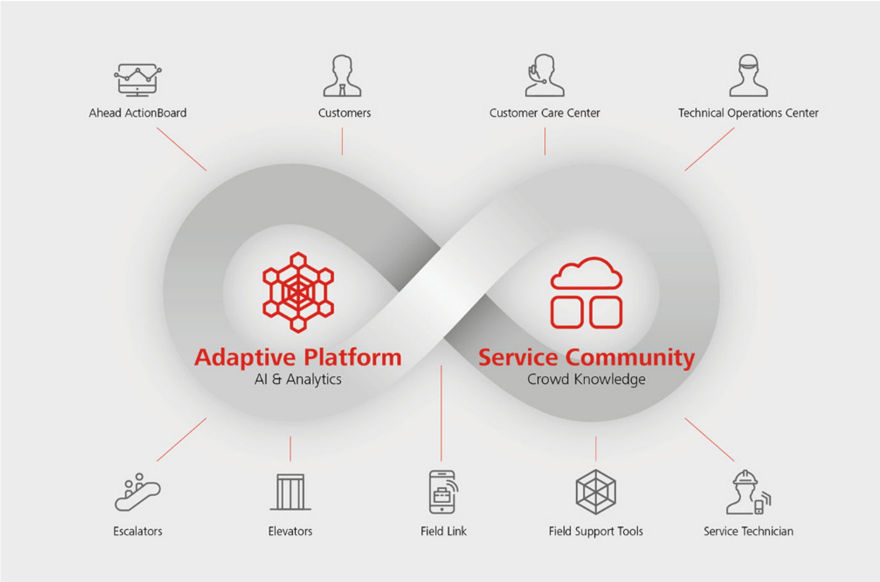

Fig. 1 Digital closed-loop adaptive maintenance process. Own illustration

offering daily support in accomplishing tasks and customer service. They are used as a single standardized user interface for service technicians.

Dynamic Planner: A digital work planning application that organizes all jobs based on prioritization and optimized travel for service technicians and subcontractors into daily schedules accessible on their smartphone's FieldLink.

Crowd Knowledge: Multilingual database and ticket system that make it possible to gather insights on technical aspects from around the world with automated translations and expert advice. Faster resolution through combined expertise with the globally combined expertise resolutions is found much faster. After a solution is found, it's automatically made available in all local languages worldwide.

Ahead ActionBoard: Digital information and portfolio management tool (web- and app-based) for customers with status and service information. Provides the correct information to work with and a single point of contact.

At its core, the focus of adaptive service is to enable the human workforce and to adapt working principles that foster a reciprocal and mutually beneficial relationship between AI/ML-driven maintenance technology and the people who conduct the maintenance. Schindler has already made many important strides in accomplishing these goals. Yet as the industry progresses and AI/ML potential expands, Schindler continues to search for new and better ways of integrating human technicians into the data-driven maintenance process.

5 Adaptive Service in Practice

Though a variety of solutions and tools can be implemented using Schindler's adaptive service methodology for the maintenance of elevators, escalators, and moving walkways, the overall goal is always to increase uptime of the elevator, escalators, and moving walkways in a safe way. Proper monitoring and maintenance are required to achieve this goal. Ideally, each unit is maintained based on its condition and with a unique maintenance plan. The industry is moving to this one-on-one relationship, but maybe achieving this state is neither commercially relevant (yet) nor as impactful as it is said. Instead of searching for the one-of-a-kind maintenance process, Schindler is moving forward to become more flexible and knowledgeable as a service crowd platform to act upon findings with its workforce, tools, and routines in maintenance.

The examples below demonstrate the closed-loop approach of adaptive services as it is already tested and implemented in Schindler:

5.1 Connectivity

The process always starts with the collection and analysis of installation and monitoring data. At present, Schindler has developed a range of products that collect data directly at the installation and pass it on to a solution that aggregates it into a clear dashboard. One such solution is the Schindler Ahead Cube, which was specifically designed to collect, analyze, relay, and act on the Internet of Things data at the edge of the network. These edge capabilities make it possible to optimize the use of bandwidth and concentrate data into the necessary tier at the necessary time—resulting in a general reduction to overall solution latency.

Gathering the data, respectively, connecting the elevator, escalators, or moving walkway can be done in two ways:

- Directly via the controller of the installation, which is called "embedded telemonitoring" (ETM). Before data is pre-analyzed in the Cube, the controller gathers and provides error codes, statuses, and other messages. A typical controller can already submit thousands of different messages that need to be "understood," combined, and analyzed and a symptom created. The smarter the controller and algorithms become, the better the diagnostic will help the human prevent or solve issues.
- Indirect via a range of sensors, which we call sensor kits that "feel what the installation (and passenger) feel." Not all or older controllers simply do not provide that much data nor insightful states. Sensors help monitor the status and condition and help watch statistics to base decisions and actions upon (Fig. 2).

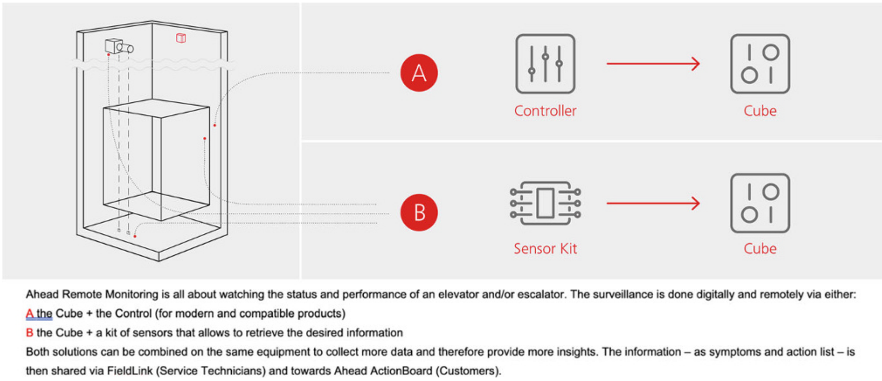

Fig. 2 Elevator connectivity. Own illustration

5.2 Insight

The analysis and prioritization of that data, in part by the system itself, and the resulting recommendations and prescribed courses of action form the core of the adaptive platform. As such, once the data is collected from the installation by the Schindler Ahead Cube, it's processed and classified based on a range of "symptoms." In fact, over 6000 different algorithms/rules are used for packaging the data into these symptoms, which are then categorized into classes. At this point, a technician can be activated and dispatched to the respective location. Dispatched service technicians receive clear information instructions through their FieldLink app, which has a very high rate of acceptance among internal technicians (Fig. 3).

The Technical Operations Centers are the new organizations combining connectivity, technical, and data science experts reviewing and closing the loop of the system. Additionally, they are performing remote maintenance tasks where the system cannot do it automatically or fast reaction time is required. The standardization of these Technical Operations Centers is ensured with a global training and certification.

The relevance for adaptive service is that the Technical Operations Centers act as a vital intersection between machine-driven analytics and the aggregation of human-based experience and expertise.

The implementation of an elevator fragility indicator into the mix is an example of what takes this approach from being condition-based maintenance to being adaptive service. By analyzing equipment-specific configuration and usage, a machine learning model extracts the maintenance demand individually and then identifies the main drivers for fragility within the model. This way, a service leader can assign the appropriate maintenance level based on data—even in advance of any elevator monitoring data and even for new units coming to the portfolio leveraging the existing insights.

Based on this analysis, installations are classified, and a service-level recommendation is made. That analysis report shows the recommended service level, the

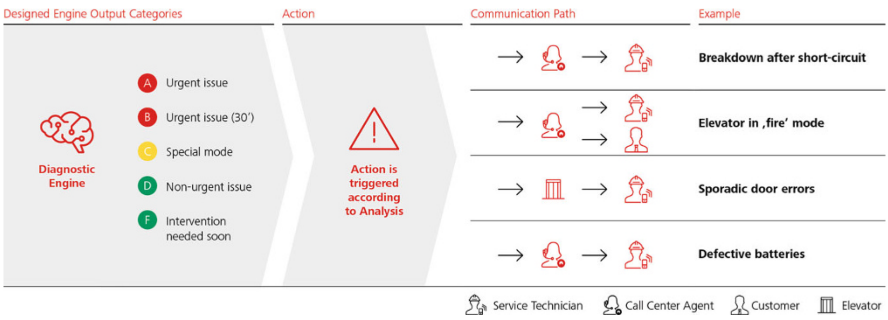

Fig. 3 Diagnostic engine. Own illustration

classified fragility level of a unit, as well as the main drivers that trigger a moderate, high, or critical fragility level. Based on this evaluation, machine-driven analytics have prioritized the installations based on the amount of attention required from their human administrators, taking a degree of the decision-making from them and at the same time concentrating their expertise and ability where needed. This is a classic example of an adaptive approach to maintenance that uses the best of both machine and human participations.

5.3 Dynamic Planner

To make the insights actionable, they must be put into meaningful information and sequence for the service technicians. In all of them, Schindler is applying the same quality and safety standards independent of the original manufacturer or age of the installation. Nevertheless, every task has different criteria to reflect this:

- Time slots (i.e., access to an elevator in a shopping mall is best before the opening to avoid friction)
- Qualification or material required
- Amount of people (typically one man or two men)
- Urgency (maintenance tasks vs. entrapment)
- Others like contractual agreements

To handle this complexity for a single service technician, a dynamic scheduling system automatically calculates and proposes the ideal sequence of the tasks. It gives different points based on the criteria, prioritizes them, and combines them in a travel time-optimized sequence. As a result, the service technicians get the respective task list on their FieldLink.

The list is still flexible enough so unforeseen events can be reported and taken into consideration in real time. So, for example, a callback takes place, and the remaining jobs of the day are pre-planned based on the new location the service technician is at.

Unnecessary travel (e.g., due to missing material) and high coordination efforts, especially for two-man jobs, are taken up by this “virtual assistant.” Additionally, tasks that need to be done in the future are already partially done when being on-site. Even though this counteracts the predictive maintenance logic of going as late as possible to the units to fix it, the network optimization has a superior optimization of the resources with its more holistic view and therefore will achieve a higher uptime for the customer as one additional visit can be avoided.

5.4 Human-Machine Interaction

The complexity of the existing installations with their different manufacturers and age of installations can be easily exhausting for service technicians, especially when it comes to non-standard situations. Particularly, as controllers of elevators and escalators have information based on codes and numbers instead of plain text, the knowledge and correct interpretation is important. At every visit, the elevator’s error log will be looked at; this is a common and broad challenge in the elevator and escalator industry.

To ensure the right information at hand, Schindler has invested in a co-creation approach with the field to define standard user interfaces to controllers. In addition to FieldLink, where the insights are shared, the FieldSupport tool for Schindler Elevator Control Interfaces harmonizes human-machine interaction for service technicians. The service technician is fully enabled with available information to evaluate the situation and make a decision for the next step.

5.5 Leveraging the Crowd Globally

Schindler maintains non-Schindler and Schindler equipment, the oldest still in operation, dating back to 1911. One can imagine the vast range of technologies that are still to be maintained, not to mention the unique solutions of a global range of manufacturers. Crowd knowledge makes it possible to educate all field force workers on all those “foreign” and “old” technologies. That way, we ensure that the 20-year-old job starter has as much access to the same knowledge, instructions, and training as a senior expert with 40 years’ experience.

The crowd knowledge platform provides technical Q&A and a ticket system in a multilingual environment. With this, a type of “Wikipedia” is built based on cases managed in the ticket system. The tickets give the field support an integrated flow of questions and answers from the field up to the research and development centers. Only when the solution has been rated as successful by the service technician will it be made available in the global library. Everyone is then able to search and access the solution and rate it. These ratings help review and ensure that the quality of the insights creates an ever-growing and ever-improving database of knowledge.

These examples of the integrated service crowd platform illustrate the ways in which adaptive service creates a new level of symbiosis between date-driven machine-based decisions and recommendations and the ability and expertise of their human counterparts. At Schindler, we assert that this is the future of maintenance and strive to develop new practical solutions that make it a reality.

6 Conclusion

The ultimate goals of Schindler Service are improved uptime, better quality, and continuous innovation. We know that innovation is not achieved through rigid development practices, and we want to encourage and enable more experimentation and open-ended research. According to Thiel and Masters (2014), "Today's 'best practices' lead to dead ends; the best paths are new and untried." In this spirit, we're looking to make innovative progress and investigate completely new possibilities in elevator and escalator maintenance. Historically, successful investors pursue a large number of sometimes competing innovation ideas either alone or with partners and push initially unsuccessful ideas back onto the market following recombination and iteration (Westerman, Bonnet, & McAfee, 2014). To take full advantage of new digital technologies, Schindler is looking to diversify its global IoEE program and adaptive service solution with multiple avenues of research.

Adaptive service is a unique way of performing elevator and escalator maintenance. It combines the latest digital technologies and processes with human expertise to maintain a unit according to its one-of-a-kind condition. The promise of IoT as the basis for digital transformation lies in "supercharging business to better serve customers and stakeholders. But to fully realize IoT's potential, companies need to approach it as a multifaceted journey, making changes to their business models and strategies—or risk ending their trip before it really begins" (Kranz, 2017). Schindler IoEE successfully proves that simply connecting a "thing" to the Internet isn't enough. We must be able to ensure that the data generated by that thing can be leveraged to enable new business benefits—and that data will ultimately be the tool of a human technician.

Yet, we want to encourage the industry and innovators at large to spend equal time and effort to find new ways to help technology support the roles of human experts. The world is at present enamored with the idea of "human-less technologies," machines, and solutions that fulfill our needs and wishes without our direct involvement in their operation. Let us not lose sight of the human factor—our own role—in the day-to-day maintenance and operation of our mobility solutions. Sharing our knowledge and finding more efficient ways of doing so have the greatest potential to revolutionize the industry. We remain convinced that building and maintaining the human networks of expertise and experience have the greatest potential to bring positive change to maintenance methodologies in the future, and we continue to explore new ways of doing that every day.

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