How a Traditional Company Seeded New Analytics Capabilities

Developing state-of-the-art data analytics capabilities is a challenge for traditional companies with long-established processes and legacy systems. We describe how one such company (a Swiss electricity utility) conducted a seed project—a bottom-up initiative to develop an analytics ecosystem of business, organizational and technological capabilities. This project was an effective first step in growing the company’s analytics capabilities. Based on this case, we provide four key lessons that can be used by other traditional companies seeking to develop new digital capabilities.1,2

Gunther Gust
University of Freiburg (Germany)

Philipp Ströhle
Karlsruhe Institute of Technology (Germany)

Christoph M. Flath
University of Würzburg (Germany)

Dirk Neumann
University of Freiburg (Germany)

Tobias Brandt
Rotterdam School of Management,
Erasmus University (the Netherlands)

Growing New IT-based Capabilities at Traditional Companies

Fueled by the Internet of things (IoT) and big data, business analytics is an essential capability for digital transformation.3 However, some long-established companies have experienced challenges in attempting to adopt new digital technologies, including business analytics, and derive value from them.4 Some organizational requirements for successfully using data-driven insights—such as horizontal communication and cross-departmental data access—are impeded by long-standing

1 Janis Gogan is the accepting senior editor for this article.
2 An earlier version of this article, Bringing Analytics into Practice: Evidence from the Power Sector, was presented at the International Conference on Information Systems (ICIS) 2016, Dublin, Ireland. The authors thank the accepting senior editor and anonymous reviewers for their excellent feedback on drafts of this article.
4 Today, only 15% of industrial companies consider analytics relevant for business success, according to a survey of 151 industry executives worldwide. However, respondents expect this number to rise to 69% within the next five years. See Lueth, K. L., Patsioura, C., Williams, Z. Z. and Kermani, Z. Z. Industrial Analytics 2016/2017 The current state of data analytics usage in industrial companies, IoT Analytics, available at https://iot-analytics.com/product/industrial-analytics-report-201617/.
structures and processes that for many years have helped traditional companies remain competitive.

Before a large, traditional company can grow a new IT-enabled capability, the ground must be prepared. An effective way of doing this is through a seed project that enables a company to gain initial experience with new tools and techniques, and to focus on the business, organizational and technical implications of the new capability.

In this article, we describe how a seed project helped a Swiss utility company (referred to anonymously as “SUC”) to develop analytics capabilities in its power-grid investment planning processes. We chose to study SUC because political and technological disruptions (especially the IoT) have put great pressure on companies in the power industry. Also, many electricity utilities were founded early in the 20th century and are burdened by the weight of structures and processes rooted in the industrial age. The SUC case history will resonate with managers in other long-established companies in industries now under heavy pressure to change: agriculture, heavy manufacturing, publishing, law, healthcare and many others.

Our aim in studying SUC was to understand the challenges and obstacles that traditional companies have to overcome to successfully launch and run seed projects. We studied how SUC developed its basic analytics capabilities and how, having laid the basic groundwork, it identified and pursued new opportunities to derive value from its data. One author of this article worked in SUC’s development team during the implementation period—November 2013 to July 2014. Other authors participated in project status meetings and conference calls as external advisors in the fields of data science and management information systems. The data that underpins the SUC case was gathered from documents, personal meetings and conference calls, starting before the seed project (in January 2013) and continuing through June 2015. Importantly, the project increased SUC’s managers’ awareness of the potential value of their company’s data assets.

Our analysis of the SUC seed project focused on three intersecting elements—business, organization and technology—and identified several key lessons that can help other long-established companies design, launch and grow their own analytics seed projects. Based on SUC’s experience, we believe that other companies should focus initially on one or a very few business processes and use an agile development approach to establish a valuable open analytics platform.

The Analytics Ecosystem and Industrial Companies

Recently, Vidgen et al. have proposed an ecosystem perspective for understanding how analytics can lead to business value. Three dimensions of the ecosystem—business (value propositions, business strategy), organization (culture, human resources) and technology (data assets, ICT strategy)—must be developed and aligned. A well-defined analytics strategy is an essential starting point, but because some long-established companies lack experience with newer digital technologies they do not currently have the knowledge necessary to formulate a meaningful analytics strategy. For example, a traditional manufacturing company may have strong processes and structures in place for producing physical goods but may not yet know how to analyze huge, newly available data sets to support decision making.

Three of the analytics-adoption challenges identified by Vidgen et al.—a shortage of data science skills, resistance to change and lack of integrated data management—are especially pronounced in long-established companies that other companies should focus initially on one or a very few business processes and use an agile development approach to establish a valuable open analytics platform.

---

5 The seed project approach is contrary to many studies describing top-down analytics efforts. See, for instance, Chen, H. M., Schütz, R., Kazman, R. and Matthes, F. “How Lufthansa Capitalized on Big Data for Business Model Renovation,” MIS Quarterly Executive (16:1), January 2017, pp. 19-34.


7 Meetings took place at SUC, the Karlsruhe Institute of Technology and the University of Freiburg. The approach of a researcher being actively involved in effecting change is referred to as “action research.” A brief introduction to this concept may be found in Baskerville, R. and Myers, M. D. “Special Issue on Action Research: Foreword,” MIS Quarterly (28:3), September 2004, pp 329-335.


9 According to a 2016 study conducted by IoT Analytics, only 30% of industrial companies have completed an analytics project.
established companies. Inexperience and insufficient knowledge about what analytics can and cannot achieve make it challenging for a company’s leaders to develop a workable analytics strategy and vision. A useful first step, therefore, is to seed and cultivate basic analytics capabilities within the organization (Figure 1).

**SUC Operates in a Transforming Energy Landscape**

With several thousand employees and about one million customers, SUC is one of the largest electricity utilities in Switzerland. Founded in the early 20th century and still partially state owned, it is vertically integrated, operating along the entire value chain of electricity generation, trading, distribution and sales.

In the second half of the 20th century, as a regional monopoly, SUC operated in a stable and mostly predictable business environment. Beginning in the 1990s, political and technological disruptions began transforming the energy sector across its value chain (see Figure 2).¹⁰

New environmental laws aimed at phasing out nuclear and fossil fuels are promoting greater use of renewable energy sources and a move away from generating power at large central plants. For SUC, phasing out a highly profitable nuclear power plant represents a major financial challenge. Meanwhile, the share of Swiss homes with solar generation units is expected to increase from fewer than 2% in 2017 to between 15% and 45% by 2035. Solar generation units and an increasing demand, especially for recharging electric vehicles,¹¹ will put unprecedented stress on SUC’s distribution grid capacity. SUC executives hope that new, but as yet unproven, smart-grid technologies—such as power storage

---


¹¹ The Swiss Federal Office of Energy’s base scenario assumes that there will be 700,000 electric vehicles in Switzerland by 2040, 16% of total vehicles.
units—might help to save costs compared with conventional grid expansion. A member of SUC’s management board summarized these developments succinctly: “The energy revolution is happening in the grid.”

SUC faces other regulatory challenges from legislation aimed at fostering competition and cost efficiency. In 2009, Swiss regulators partially lifted the regional monopoly on electricity sales; SUC was required to open its service area to third-party providers. In 2013, regulators adopted new benchmarks that push grid operators toward higher cost-efficiency. In the medium-term future, industry experts expect more new laws to be passed, further increasing competition.

In summary, SUC expects lower revenues (mostly due to stricter grid regulations and phasing out its nuclear plant) and complex new operational challenges. To maintain its profitability, the company needs to reinvent its business model and replace old planning processes with new, smarter methods of grid planning. Members of the management board summed up this challenge: “Traditional methods of network expansion are expensive. We are meeting our social responsibilities by researching and building smart solutions.”

### Project to Seed Analytics Capabilities in SUC’s Grid Planning Ecosystem

Table 1 summarizes SUC’s grid planning business-organization-technology ecosystem. In early 2013, a mid-level executive launched an analytics project to help produce a five-year update of the 30-year distribution grid investment plan, which was due in late 2014. This executive project sponsor assigned leadership of the analytics project to an ambitious young professional with five years of industry experience working on similar projects in long-term grid planning and industry forecasting. This individual had previously collaborated with academic researchers to conduct industry studies and had published several academic papers. He also had a string of successful projects under his belt and was therefore considered an SUC thought-leader on new grid technologies and planning methodologies.

The analytics project leader was dissatisfied with SUC’s legacy planning procedures, which were based on coarse historical extrapolations. Although these procedures were similar to those of others in the industry, he considered them to be obsolete because they could not account for the likely disruptive impact of new technologies—especially solar generation and electric-powered vehicles. He had a basic understanding of analytics, thanks to his engineering training, and was aware of new data-driven analytics techniques. He wanted the seed project to help increase managers’ and engineers’ awareness of how and why data analytics could add value, and he believed the project would help strengthen SUC’s position as a sought-after expert on grid planning. In his view, a strong foundation in data analytics would complement the company’s excellent technical planning capabilities.

Drawing on his prior experience, the project leader proposed that the project be conducted in-house, in conjunction with experts from academia. He argued that this would be less costly than hiring professional consultants and that his experience had taught him that “every Swiss franc we invest [in collaborations with academia] usually yields a highly leveraged return.” The sponsoring executive, himself linked to academia with a postgraduate degree, agreed with this approach and approved the initiative. In June 2013, the project leader contacted
his alma mater and assembled a development team consisting of a Ph.D. student (one of the authors), three part-time members from strategic and operational functions within the SUC grid planning department and three interns (master’s-level students).

Figure 3 maps the seed project phases to SUC’s analytics ecosystem. First, the project focused on the business domain by establishing a strategic goal: to achieve immediate operational benefits from an analytics project and to increase managers’ awareness and acceptance of data analytics. Next, the organizational domain came into focus when inter-departmental communication and the engagement of additional staff helped the project team gain access to required data sources. The technology domain moved to the fore when the team selected a suitable analytics platform and began developing the analytics applications. In the final phase, the developed system was evaluated against the initial business requirements.

**Phase 1: Identify Business Value Opportunities Using Process Know-how (Set Project Scope)**

The seed project started in mid-November 2013. In the first two weeks, the project scope was established in a series of workshops and meetings. Although the aim of the project was to improve long-term grid planning, the project leader decided to take a broader perspective by drawing on multiple stakeholders with different backgrounds from different grid division departments (the grid planning department is one of five departments in the SUC grid division). He wanted the seed project to be rooted more widely within SUC so that any successes achieved in the project would be more readily institutionalized and new analytics knowledge and skills would be transferred to the
appropriate departments. He was optimistic that other departments would learn from the seed project and then conduct their own analytics projects to support other processes—such as operative grid planning and asset management.

The project manager therefore ran a large kick-off workshop with 25 participants (managers, project leaders and planners) from several grid division departments. The workshop goal was to identify analytics value opportunities in the grid division. The seed project team started the discussion by suggesting some illustrative scenarios from different areas of the grid business, such as:

- Asset management scenario: “In rural areas, the share of overhead lines traversing forest areas is x% above average. This relates to an increase of y% in service disruptions.”

- Grid planning scenario: “Expected penetration of solar generation in villages is x. Since this exceeds capacity limits of our grids in these areas by y, there is a considerable need for reinforcement investments.”

Participants were encouraged to identify the grid-related problems they would be most eager to solve if they had better information. During the workshop, a long list of possible analytics applications was compiled (some of which are shown in Table 2) and then iteratively prioritized with the project sponsor. The long-term planning process, which was given highest priority, encompasses capital expenditures (CAPEX) analysis, capacity limit detection and grid reliability analysis.

### Phase 2: Articulate Vision and Set Seed Project Goals

With long-term grid investment planning chosen as the highest priority, in December 2013, the seed project team analyzed the legacy (as-is) grid planning process to identify the requirements for a new analytics system. The legacy process and associated problems are summarized in Figure 4.

As shown in Figure 4, the legacy long-term grid planning process had six steps:

1. Senior industry experts across all divisions of SUC generated scenarios for the development of the electricity sector, including expected future supply and demand levels. From these scenarios, they derived performance requirements for distribution grids.

2. Grid planners sampled a small number of the several thousand grids owned by SUC, which were selected based on settlement characteristics of geographic areas (e.g., village or town).

<table>
<thead>
<tr>
<th>Application</th>
<th>Supported Processes</th>
<th>Expected Value</th>
<th>Seed Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated detection of capacity limits</td>
<td>Long-term grid planning</td>
<td>More accurate investment planning, reduced overhead</td>
<td>✓</td>
</tr>
<tr>
<td>Capital expenditure (CAPEX) analysis</td>
<td>Long-term grid planning Asset management</td>
<td>More accurate investment planning</td>
<td>✓</td>
</tr>
<tr>
<td>Reliability analysis</td>
<td>Long-term grid planning Asset management</td>
<td>More precise estimates of service interruptions</td>
<td>✓</td>
</tr>
<tr>
<td>Assisted reinforcement planning</td>
<td>Long-term grid planning Operative grid planning</td>
<td>Increased throughput and increased decision quality</td>
<td>✓</td>
</tr>
<tr>
<td>Technology potential analysis</td>
<td>Operative grid planning</td>
<td>Development of planning guidelines increases throughput</td>
<td>×</td>
</tr>
<tr>
<td>Revenue analysis</td>
<td>Asset management</td>
<td>Differentiated investment planning</td>
<td>×</td>
</tr>
<tr>
<td>Active grid operations</td>
<td>Grid operations</td>
<td>Reduction of grid investments</td>
<td>×</td>
</tr>
<tr>
<td>Impact analyses for supra-regional grids</td>
<td>Long-term grid planning (supra-regional grids)</td>
<td>More detailed investment planning</td>
<td>×</td>
</tr>
</tbody>
</table>
3. Data on individual components (e.g., power lines, transformers) of the sample grids was manually transferred into a Microsoft Excel spreadsheet template.

4. The Excel spreadsheet aggregated grid data to create a small number of synthetic reference grids representing the sample.

5. Planners manually transferred the reference grids into power-flow software to evaluate the grids against the performance requirements created in step 1.

6. The results from step 5 were extrapolated to the entire population of SUC grids, to guide development of the investment plan.

By first identifying the problems associated with the legacy process, the seed project team was able to quickly specify analytics requirements that better aligned the grid planning process with SUC’s rapidly changing business environment. The team identified four goals for the analytics seed project.

**Goal 1: Design a Faster Long-term Planning Process.** The legacy grid planning process involved many time-consuming manual steps, and the new system should be designed to automate many of these steps. Also, uncertainty about the timing of development and commercialization of transformative technologies (such as electric vehicles and solar generation) meant that more frequent planning updates, based on evaluating a wider range of scenarios, were necessary. Thus, improving processing speed was a very important goal.

**Goal 2: Increase Planning Accuracy.** Most stakeholders (and certainly the project leader) recognized that subjective expert assessments and traditional planning heuristics should be abandoned; measuring and improving planning accuracy was a principal goal for the seed project. The project leader explained, “We need to know the accuracy of our planning procedures, to add credibility to the output.” To account for inaccuracies arising from subjective assessments, safety margins had always been incorporated into investment plans. When the business environment was stable, those margins were low, and some degree of overprovisioning was tolerated. Now, however, with increased technical and regulatory uncertainty, together with increased demand for electricity, there is a need for much larger safety margins. This translates into a requirement for a greater degree of precision in investment planning.

**Goal 3: Increase Planning Flexibility.** The December 2013 grid planning workshop yielded a list of four applications that a new planning system should be able to handle (As shown in Table 2). However, it was evident that, given current industry dynamics and the associated uncertainty, this list would likely expand over time. The analytics system would therefore need to be a versatile, extensible tool that could be incrementally adapted to support new scenarios and new types of analysis.

**Goal 4: Improve Reproducibility.** Time-consuming manual analysis and non-automated data exchange between systems limited the speed, accuracy and reproducibility of the legacy planning...
process. Problems were caused by both human error and incomplete process descriptions, leaving too much room for personal interpretation. The tedious manual data collection process was particularly error-prone due to copy-and-paste mistakes. During visual inspection and classification of grids, non-objective assessments were unavoidable. As a consequence, many legacy planning steps yielded different outcomes each time they were executed, even when using the same input data. Poor reproducibility led to time-consuming and frustrating discussions between grid planners as they attempted to justify individual planning decisions. An important goal of the seed project was therefore to increase the reproducibility of the long-term grid planning process.

**Phase 3: Address Data Access Challenges**

A senior manager highlighted the value of precise knowledge of grid assets as an essential prerequisite for a business analytics project: “The profound knowledge of our physical assets is our core competence, especially with this [uncertain] future ahead.” However, gaining access to all of the necessary data involved major struggles that threatened the seed project’s success. Although the various data sources (from several SUC departments) were scheduled to be integrated in the seed project as of January 2014, some data sources were not integrated until April. From a technical (data architecture) standpoint, two main challenges impeded the team’s ability to integrate the required data:

1. Common data repositories did not exist, so it took the team a long time to compile an overview of available data sources. Data sources were scattered across different IT systems in different SUC divisions (see Figure 5).

2. There were many data harmonization problems.

These challenges were compounded by a culture that did not foster the sharing of information, data and knowledge, either within or between departments. Some data sources were only discovered after the project leader invited additional staff to project status meetings. At one meeting, the project team was discussing problems with the quality of manually collected grid data. An invited manager revealed that he was about to complete a project with a geographic information systems (GIS) service provider. He explained, “We have been developing an interface to our GIS service provider to make our grids digitally accessible. It should be possible to provide you with [digitized] data access.” Although this manager worked in the same department, the seed project team was unaware of this initiative. As a consequence, this digitized grid data did not become available until several weeks after Phase 4 (platform selection) had begun.

**Figure 5: Scattered Data Sources Caused Data Integration Problems**
In another example, the availability of relevant service area data was discovered only thanks to the well-connected project leader, who proactively communicated information about the seed project throughout SUC. The existence of the service area data came to light after he sent a member of the project team to an adjacent department to give a talk about the analytics project. Even so, this data did not become available until early April 2014, two months after application development had started. The seed project team was therefore hindered by the lack of a culture that fosters data and knowledge sharing, especially at lower levels in the organizational hierarchy.

An example of a data harmonization problem is provided by CAPEX analysis, which relies on accurate data about prices paid for various grid components. Power grid asset life cycles span about 50 years, and over time many different types of equipment had been installed in grids, with many of the components not listed in the engineering department’s procurement database. In a time-consuming effort to classify equipment correctly, the project team manually compared non-listed grid assets to similar items. Another data harmonization problem arose from a project to develop an interface with the sales division’s information system (to make consumer contracts available). This project was hindered because of incompatible database keys.

The seed analytics project uncovered several data sources that were previously not known about, and it was often the case that there was more than one data source that could fulfill the requirements of an application. When deciding which sources to integrate into the analytics database, the project team focused first on those of low complexity. For instance, the team decided to base estimates of consumer loads on grid assets. More complex data sources—such as consumer contracts and bills (updated yearly), as well as real-time sensor data (updated within seconds)—were deferred, because these required more advanced IT and better trained staff.

**Phase 4: Select an Open Analytics Platform**

Initially, no additional technical or organizational constraints (IT or user requirements) were placed on the seed project team. However, the project leader recognized that SUC’s changing business environment created new requirements for grid planning. The project team had only limited experience with specialized functionalities for grid analysis (such as converting data into graph structures and parsing it top-down or bottom-up). Because grid analysis was required for all applications, the team conducted pilot tests to evaluate the required functionalities on different platforms. In February and early March 2014, the team evaluated three possible platforms for the new analytics system through pilot tests, each of which took about two weeks. The three possible platforms were:

- Microsoft’s Excel spreadsheet tool
- A proprietary power-flow suite provided by one of SUC’s software partners
- The R open-source analytics platform.

The pros and cons of each platform are summarized in Table 3.

The first two platforms were already in use in the grid planning department, but the project team included R in the comparison because of its widespread use in academia. During the pilot test

<table>
<thead>
<tr>
<th>Table 3: Pros and Cons of Analytics Platforms Considered by SUC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MS Excel</strong></td>
</tr>
<tr>
<td><strong>Pros</strong></td>
</tr>
<tr>
<td>Pros</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

September 2017 (16:3) | MIS Quarterly Executive 223
iterations, new user and IT-related requirements emerged, but the project leader initially focused on integrating the platforms into existing software suites and minimizing adoption requirements. He stated: “If necessary, we can pass on some functionality if it ensures lower initial burdens for grid planners.” At first, he argued for the Microsoft Excel spreadsheet solution, but testing revealed that Excel’s analytic capabilities were too limited (for example, its limited graph processing functionalities would need time-consuming work to create the required analysis routines).

The power-flow suite had convenient functionalities for importing grid data and also offered highly accurate power-flow calculations. However, the power-flow functionalities were insufficient for CAPEX and reliability analytics applications. This platform was eventually discarded because its API offered only limited extensibility, and external implementation was not an option.

To start with, the project leader was not enthusiastic about the R platform; he stated: “I do not want to introduce yet another platform into our fragmented IT landscape.” He feared that initial usage barriers would be too high. However, some recent hires did have experience with R, and the pilot test revealed that—thanks to flexible interfaces—data sources from various SUC IT systems could be integrated into R with minimal effort. Also, extensive open-source libraries offered specialized packages for graph analysis, including built-in functionalities for grid parsing. Thanks to these features, a mockup that converted lists of grid components into structured graphs (representing the power grid structures) was created in a few hours. In contrast, developing comparable features in Excel took two weeks. In the end, R’s rapid prototyping capability convinced the project leader to adopt this platform for developing the new analytics system.

**Phase 5: Develop and Implement Applications in Incremental Steps**

The analytics applications were developed using an agile approach with repeated design iterations. This enabled the new system to be developed in a modular way and also facilitated learning new technology skills on the job for the stakeholders—the grid department’s sponsoring executive, the project leader and system users—and mitigated resistance to change. During the initial design phase, in March 2014, generic grid-processing functionalities were developed. During the next two months, each successive design iteration yielded an individual analytics application.

The project team kept stakeholders up to date with development progress in frequent review meetings. Because participants in these meetings often raised new ideas, it was particularly helpful that experts who were not on the team were on hand to answer questions and provide feedback. For instance, during the presentation of an application that determined power feed-in limits, one participant suggested that the project team include a rooftop solar potential analysis based on building data available in his department. Since the proposed rooftop solar application would require only minimal development effort, the project leader decided to run an additional “sprint” to develop it—and thus achieved a quick-win.

Discussions between the project team and experienced grid planners revealed potentially transformative ideas for follow-up initiatives. One team member, who had a strong background in analytics, identified a technically feasible application: “Since we can automate the detection of capacity limits, we can also automate investment planning.” The project leader then drew on his own grid planning expertise to identify a business opportunity that built on this idea: “We could take this one step further. Since we can run automated analyses, we can determine cost-optimal reinforcement investment paths over time, simulating uncertainty.”

The agile development approach also helped to identify and mitigate resistance to change. Internal resistance came primarily from grid planners, who frequently challenged the new analytics system’s output and defended their existing manual procedures. One planner insisted: “This will never be as accurate as a manual approach.” Involving the planners was helpful because it gave the project manager multiple opportunities to explain that a goal for the system was to make it possible to direct planners’ attention to value-adding activities and free them from tedious and time-consuming manual processes. Over time, the planners’ skepticism diminished.

Some resistance to change stemmed from external factors, such as industry norms, guidelines and regulations. At times, the project sponsor recognized the superiority of a proposal but put its development on hold because of industry standards:
“In theory, I understand the benefits of a proactive reinforcement planning application, but the regulator will not reimburse such simulation-based investment decisions.”

The modularity of the analytics system provided some opportunities to gradually move away from entrenched industry practices. For example, rather than classifying grids by service area settlement type (rural, city, industrial), the project team believed that a clustering approach based on physical characteristics of a grid would more accurately represent the population of grids. When this was brought up in a review meeting, the project leader initially resisted: “I see your point, but this approach is the industry standard, the way of communicating within SUC and the industry. We need to stick with it.” Implementing this new method would, however, require minimal additional effort, so he eventually agreed to include both functionalities—reasoning that planners could revert to the industry standard whenever communication was an issue.

Toward the end of the seed project, grid planning department staff began to develop and implement their own ideas for new analytics functionalities. One employee created an interface to transfer analytics results back to the geographic information system for more convenient data inspection and visualization.

**Phase 6: Evaluate Both Immediate Business Value and Long-term Potential of Analytics**

In the seed project’s final two weeks (June 2014), the new system’s impact on long-term planning processes and outcomes was evaluated by the project team and the grid planners. Figure 6 shows that benefits were gained throughout the grid planning process. The evaluation revealed that the new analytics capabilities improved SUC’s grid investment planning by making it more reliable and versatile. The accuracy and flexibility of long-term investment planning improved, and both processing time and required staff resources were greatly reduced. SUC could now initiate planning procedures on a more flexible basis, as required by rapid technological developments and changing customer demands. In addition, several follow-up initiatives to extend the analytics capabilities were identified.

By achieving the four goals for the analytics system, the seed project yielded the benefits described below.

**Goal 1: Faster Long-term Planning Process.**

By eliminating or automating process steps, total process cycle time was reduced from months to weeks. Because the new system processes all grids in an automated fashion, the second step of the legacy process (sampling and grouping) was eliminated completely. Particularly impressive gains in planning speed were obtained by automating several (previously manual) data-transfer and structuring activities (Figure 6, step 3). Activities that had previously taken several person-months of effort now took minutes. Even for several thousand grids, the new grid parsing functionalities supported rapid calculation of required parameters and typical grids within minutes. One planner recalled that time-consuming data preparation procedures had been the major reason why SUC was not able to offer planning services to other grid operators: “The digital processing capabilities make it much more

---

**Figure 6: Improvements to the Legacy Planning Process Provided by the Seed Project**

![Figure 6](image.png)

**Reduced Process Runtime**

- **Software:**
  - Power Grid Data
- **Investment Plan**
- **1. Scenario generation**
  - Updated Duration: Weeks
  - Increased Reproducibility by eliminating subjective sampling
- **2. Sampling and grouping of grids**
  - Days
- **3. Data transfer and structuring**
  - Months
  - Increased Accuracy through full data access
  - Minutes
  - Increased Flexibility by multi-dimensional analyses
- **4. Construction of representative grids**
  - Days
  - Seconds
- **5. Analysis of representative grids**
  - Days
  - Hours
- **6. Extrapolation**
  - Minutes
- **Reduced Process Runtime by automation**

---
attractive for ourselves and the customer to sell our expertise as a service.”

Planners no longer need to spend time transferring grid data between different software tools. Analysis and extrapolation are partially automated, although for some complex tasks—such as long-term investment budgeting—grid planners still manually analyze data using the power-flow software. For simpler analysis tasks, such as identifying future grid bottlenecks, planners now conduct fully automated simulations.

Improved planning speed has greatly enhanced SUC’s grid planning capability. Although SUC already considered its grid planning capabilities to be a strength, the grid planning department is now seen as a decision support powerhouse. Liberated from mundane, error-prone, time-consuming manual processes, empowered grid planners now have more time to consult on tactical and strategic matters.

**Goal 2: Increase Planning Accuracy.** Grid planners no longer have to rely on sampling; they now evaluate the entire set of distribution grids. This improved accuracy translates into better investment decisions. Before the seed project, planners evaluated grid characteristics of a sample of typical grids, which were assumed to represent a homogeneous group (corresponding to the “steps” in the left-hand panel of Figure 7 for five typical grids). Using the new analytics system, planners effortlessly compute these characteristics for each grid individually, resulting in the fine-grained curve on the right-hand side of Figure 7. The horizontal lines on both the left- and right-hand panels represent expected electricity generation by 2035. The legacy approach would have overestimated the investment needed because it estimated that about 3,600 grids needed to be reinforced. The new analytics system more accurately estimates that about 2,800 grids will need to be reinforced (a 22% reduction). Assuming an investment of 30 thousand SFr ($31.4 thousand) per grid, the new analytics approach yields investment savings of about 24 million SFr ($25.1 million).

More accurate investment suggestions reduce the uncertainty of grid planning. SUC can reduce the safety margins applied to planning computations, and planners and managers now make better-informed decisions about the risks and benefits associated with new energy technologies. From a technical perspective, SUC can more precisely estimate the amount of stress that grids will be

13 For reasons of commercial confidentiality, the numbers in this example are stylized. The divergences between the two approaches vary depending on the application and scenario.

**Figure 7: The Analytics System Provides a More Accurate Estimate of the Number of Grids Needing to be Reinforced**

![Diagram showing the comparison between Legacy Approach and Analytics System](image-url)
subject to in the future from new developments and innovations, including solar generators and recharging electric vehicles.

**Goal 3: Increase Planning Flexibility.** The analytics system improves on standard power-flow calculations by supporting both analysis of more long-term scenarios and more dimensions of grid planning. This added flexibility translates into benefits across all three dimensions of the analytics ecosystem:

- From *a business* perspective, investment decisions are more robust. Planners no longer need to consider basic applications sequentially or in isolation; the system facilitates joint analysis of multiple applications, either by replacing systems or tailoring individual applications that integrate separate information systems. Planners can now create complex reports that simultaneously take into account different applications.

- From *an organizational* perspective, planners no longer need to work with multiple tools in parallel, which reduces set-up times and data-transfer overhead. In addition, the smaller number of tools reduces the burden on users and the amount of initial training required.

- From *a technical* perspective, the new analytics applications take advantage of reusable functionalities and data sources. This stands in stark contrast to the legacy procedures, which involved many incompatible, task-specific information systems.

**Goal 4: Improve Reproducibility.** The analytics system resolves many reproducibility problems by automating most of the planning process. Grid planners no longer conduct subjective and error-prone sampling and grouping procedures. The few remaining manual tasks occur in specific process steps, greatly reducing the possibility of human error and subjective judgements. The system’s visual planning assistance functionality also leaves less room for subjective personal interpretation.

**Future Business Opportunities.** In the final phase of the seed project, SUC also evaluated the long-term potential of analytics. During application development, stakeholders had proposed system extensions that would create valuable new options (see Table 4). A proposal to further automate the planning processes has the potential to yield both additional efficiency gains and improved decision quality. A suggested new proactive planning methodology offers significant cost-reduction potential compared with the industry standard. Finally, the standardized interfaces created during the seed project now make it possible for SUC to sell its planning services to other grid operators.

**Key Lessons from the SUC Case for Analytics Seed Projects**

We mapped insights from SUC’s grid planning analytics project to the key challenges identified by Vidgen et al. (Table 5). This table summarizes the multifaceted challenges associated with establishing data-driven analytics and decision making in an organization that was previously deeply rooted in process specialization (geared toward efficient, high-quality production).

The following short-term challenges are particularly relevant for the success of an analytics seed project:

<table>
<thead>
<tr>
<th>Extension</th>
<th>Supported Processes</th>
<th>Expected Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated reinforcement</td>
<td>Long-term grid planning</td>
<td>Scenario analyses become a routine procedure and thus increase decision quality</td>
</tr>
<tr>
<td>investment planning</td>
<td>Operative grid planning</td>
<td>Decreased process run-time and labor intensity</td>
</tr>
<tr>
<td>Proactive reinforcement planning</td>
<td>Operative grid planning</td>
<td>Redefinition of the status quo of grid planning methodology</td>
</tr>
<tr>
<td>Planning as a service</td>
<td>Long-term grid planning</td>
<td>Additional revenue from new service offerings</td>
</tr>
<tr>
<td></td>
<td>Operative grid planning</td>
<td></td>
</tr>
</tbody>
</table>
The seed project should reveal new sources of business value (business dimension of the ecosystem).

The project should facilitate follow-up initiatives by developing basic technological skills among staff and thereby reducing resistance to change (organization dimension).

An analytics seed project requires access to relevant data sources (technology dimension).

Based on these immediate challenges, we have derived the four key lessons shown in Table 5 and described below. These lessons will help other long-established, traditional companies to successfully...

---

### Table 5: Analytics Challenges, Insights from SUC’s Seed Project and Associated Lessons

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Seed Project Experience</th>
<th>Lesson</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish a business case for analytics</td>
<td>• Analytics reduces overhead of internal processes</td>
<td>Leverage process focus</td>
</tr>
<tr>
<td></td>
<td>• Several future business opportunities identified through interaction of domain and analytics experts</td>
<td></td>
</tr>
<tr>
<td>Use analytics to improve decision making</td>
<td>• Analytics increases planning process accuracy</td>
<td></td>
</tr>
<tr>
<td>Measure customer value impact</td>
<td>• Planning process has reduced response time and can be initiated more flexibly</td>
<td></td>
</tr>
<tr>
<td>Overcome resistance to change</td>
<td>• Resistance to change originates from both internal, entrenched processes, and external industry norms and standards</td>
<td>Foster data awareness</td>
</tr>
<tr>
<td></td>
<td>• Involving users during development helps overcome internal resistance to change</td>
<td></td>
</tr>
<tr>
<td>Develop analytics and data skills among staff</td>
<td>• Involvement of stakeholders in agile development facilitates learning on the job</td>
<td>Adopt agile development practices</td>
</tr>
<tr>
<td></td>
<td>• Employees begin to implement new applications</td>
<td></td>
</tr>
<tr>
<td>Produce credible analytics</td>
<td>• Analytics improves reproducibility by removing subjective manual procedures</td>
<td></td>
</tr>
<tr>
<td>Build a data culture</td>
<td>• Senior management pushes IT initiatives; however, a culture of communicating and sharing data is lacking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Well-connected project manager compensates for lack of data awareness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Employees identify business opportunities that challenge the status quo as defined by the regulator</td>
<td></td>
</tr>
<tr>
<td>Provide data access</td>
<td>• Agile development helps to reveal data sources and to flexibly implement additional applications (quick-wins)</td>
<td>Move from isolated tools to open platforms</td>
</tr>
<tr>
<td>Manage restrictions of existing IT platforms</td>
<td>• Existing software does not support multi-purpose analytics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Open analytics platform is suited to integrating data from fragmented IT systems</td>
<td></td>
</tr>
<tr>
<td>Generate appropriate data to support analytics</td>
<td>• SUC’s physical infrastructure generates extensive data</td>
<td></td>
</tr>
<tr>
<td>Manage data quality</td>
<td>• Incompatible databases revealed data consistency problems across SUC’s systems</td>
<td></td>
</tr>
</tbody>
</table>

---

14 Top challenges to creating business value from analytics, according to a practitioner survey by Vidgen et al., 2017.
initiate and carry out analytics seed projects. They also address two key ingrained characteristics of some large, traditional companies: a high degree of process specialization and limited analytics capabilities.

**Lesson 1. Leverage Process Focus**

SUC employees identified problems and bottlenecks in the established long-term grid planning process, making it easy to articulate clear requirements and goals for the seed project. In companies that lack experience in implementing new types of IT applications, the potential benefits of analytics may not be evident at first, and the business case for analytics may seem too limited to attract significant buy-in. Piggybacking an analytics seed project on accepted and well-known processes can be an effective way of developing analytics capabilities.\(^{15}\) Like SUC, many large, traditional companies have tried-and-tested business processes. At SUC, the focal process chosen for the seed project—grid planning—encompassed several applications and departments. With many stakeholders involved, there were multiple opportunities for follow-up initiatives to further cultivate the nascent analytics capabilities.

**Lesson 2. Foster Data Awareness**

Discovering available data sources was a major struggle at SUC. Even though senior managers pushed IT-related innovations, these efforts were hampered by a weak data-sharing culture. Data “blindness” is not uncommon in companies with hierarchical organizational structures, highly specialized units and limited inter-departmental collaboration—especially if managers focus on tangible inputs, processes and outputs. Given the importance of data access for a successful analytics initiative, it is absolutely essential to foster data awareness, both before and during an analytics seed project. At SUC, joint projects and workshops helped encourage information exchange across departmental boundaries.

---

15 See Wixom, B. H. and Ross, J. W. “How to Monetize Your Data,” *MIT Sloan Management Review,* January 2017, available at [http://sloanreview.mit.edu/article/how-to-monetize-your-data/](http://sloanreview.mit.edu/article/how-to-monetize-your-data/). Based on several case studies, this report states that improving internal processes is “the most immediate way” to benefit from data analytics. The report also notes that financial returns were often underestimated by executives.

**Lesson 3. Adopt Agile Development Practices**

Agile development enabled SUC staff to learn iteratively about analytics, leading both the seed project team and grid planning staff to identify further business opportunities, and empowering planning staff to develop applications on their own. At many large, established companies, all three dimensions (business, organization, technology) of the analytics ecosystem are underdeveloped. Frequent design iterations involving a broad audience during application development helps ensure a common standard and facilitates mutual learning across all three dimensions. At SUC, for example, new business insights, shared during project status meetings, improved application development. Also, employees find it easier to understand the incremental development updates that characterize agile development, as compared with radical upgrades.

**Lesson 4. Move From Isolated Tools to Open Platforms**

Prior to the analytics seed project, SUC had tailored many different software tools to support specialized tasks. A new, open analytics platform reduced the IT fragmentation by integrating applications across various aspects of grid planning. Use of predefined packages from R’s online community reduced development cycles and enabled quick-win implementations.

Many large, well-established companies rely heavily on enterprise systems, but often they have not articulated an overarching software strategy beyond ERP. Using many individual software tools to solve many individual problems makes it difficult to take adjacent applications into consideration. However, the value of an analytics capability increases as both available data sources and applications increase. An analytics seed project should therefore reduce IT fragmentation by integrating tools and data sources via a general-purpose, open platform solution. This might mean rejecting the best tool for a given task in favor of a tool with better integration potential. A case in point was SUC’s power-flow engineering software: Its superior precision in engineering calculations was not sufficient to overcome the limitation of its lack of interfaces, so it was replaced by a simpler, platform-enabled application.
Unlike closed, monolithic software suites, there is an abundance of packaged modules for open platforms available from code repositories that are supported by active development communities. Making use of these modules reduces development cycle times and prototyping costs, and enables a firm to experiment with new analytics processes during a seed project and easily integrate follow-up applications.

**Concluding Comments**

Many large, traditional companies have found that moving toward data-driven decision making is challenging. Although their analytics capabilities may be underdeveloped, the good news is that these companies usually have complementary human and technology capabilities that can be leveraged. At a manufacturing company, for example, many employees possess extensive engineering knowledge and are eager to learn. Industrial services (such as electricity distribution) often generate vast amounts of data from which significant value can be derived, once access and interoperability challenges have been overcome.

A seed project is an effective way of improving an organization’s readiness for analytics. Unlike large, top-down initiatives, seed projects require comparatively few resources. Their small scale facilitates learning-by-doing and internal collaboration. As the seed starts to grow and new business insights are shared during project status meetings, the organization begins to reap initial business value from analytics, and lays the groundwork for an ongoing analytics transformation.

**About the Authors**

**Gunther Gust**
Gunther Gust (gunther.gust@is.uni-freiburg.de) is a Ph.D. student in Information Systems Research at the University of Freiburg. He earned a BSc and an MSc in Industrial Engineering and Management, both from Karlsruhe Institute of Technology. He holds doctoral fellowships from the Heinrich Böll Foundation and the German National Academic Foundation. His research focuses on analytics and decision support in energy and smart cities.

**Christoph M. Flath**
Christoph Flath (christoph.flath@uni-wuerzburg.de) is Assistant Professor of Information Systems and Operations Management at the University of Würzburg. He holds a diploma degree in Industrial Engineering and Management and a doctoral degree in Information Systems from Karlsruhe Institute of Technology. His research interests include cyber-physical systems in energy, industry and transportation, as well as big data analytics.

**Tobias Brandt**
Tobias Brandt (brandt@rsm.nl) is Assistant Professor of Business Information Management at Rotterdam School of Management, Erasmus University. His research focuses on the digital transformation of cities, with applications in urban mobility, smart energy systems and others. He is also co-founder of the data science company Geospin, which provides analytical services to various leading industrial companies.

**Philipp Ströhle**
Philipp Ströhle (philipp.stroehle@gmail.com) is a project manager and analytics expert for IoT projects in the lighting industry. He holds a diploma in Business Engineering (2010) and a Ph.D. in Information Systems (2014), both from Karlsruhe Institute of Technology. His research focuses on optimization and online mechanism design, with applications in energy and mobility systems.

**Dirk Neumann**
Dirk Neumann (dirk.neumann@is.uni-freiburg.de) holds the Chair of Information Systems of the University of Freiburg, Germany. His research topics include business analytics, text mining and optimization. He studied information systems in Giessen (Diploma) and Economics in Milwaukee, U.S. (Master) and earned a Ph.D. from Karlsruhe Institute of Technology in 2004.