The E Doesn't Stand For Easy: EIS in the Real World

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ABSTRACT

Energy Information Systems (EIS) entice potential users, for many reasons. EIS tools promise insight into energy performance and tools for the deeper engagement of both corporate-level staff (executives and management) and facility-level staff (engineers and technicians). Corporate staff appreciate the automated reporting capabilities that can provide them tailored data, when they need it. Facility managers jump on an opportunity to leverage "big data" and show the impacts of their hard work on energy efficiency. Utilities increasingly offer programs to help support their customers in developing strategic energy management (SEM) plans, which can include acquiring and leveraging an EIS for energy tracking proposes.

This paper presents observations and results from implementing EIS in a small sample of facilities that were incentivized to install and use EIS systems. On the whole, customers achieved energy savings as a result of their use of the EIS. However, the process to install, launch, and use the energy information system presented barriers. Specifically, installation periods were longer than expected, sometimes taking as long as 17 months. Data collected for this research comes from two sources: 1) a project funded by a Minnesota Department of Commerce research grant and 2) a utility's EIS pilot program.

The authors document specific recommendations for improving the EIS procurement process for building managers, and improving the outcomes for utility programs. Because utility companies are increasingly offering rate-payer funded incentives for the installation EIS tools, it is important that they are utilized and lead to identification and implementation of energy saving projects.

The success of an EIS relies on a corporate culture supportive of energy efficiency, such as one developed through SEM. Because EIS don't, in and of themselves, save energy, EIS implementation must be accompanied by robust management practices to actually yield savings. While one could argue that data is necessary and essential to successful energy management, the experience in this study shows that the reverse is perhaps more true: a well-developed culture of energy management is more important than the best energy data. The most important first step for companies to take is to engage in elementary SEM practices, like setting a goal, evaluating current practices, and assigning staff to energy management. EIS tools, while alluring, need utility and customer engagement and understanding to succeed within an effective energy management program and utility energy efficiency portfolio.

Introduction

Commercial building operators run their buildings with varying degrees of feedback. While HVAC controls in a Building Automation System (BAS) are increasingly common in large buildings, only 10% of all commercial buildings have a BAS (Katipamula et al. 2012). Even for those buildings that have operational data from a BAS, the data rarely includes energy performance. Operators know their building uses energy because they receive monthly bills, but they often have trouble linking their specific actions to their building's energy performance.

Factors like weather and schedule changes muddy the water for operators who get frustrated when savings don't show up on the bill.

Enter the energy information system (EIS). EIS are tools that collect, store, display and analyze energy data. Through the installation of interval meters at the building's main electric and natural gas meters (and perhaps some key sub-meters on large loads), energy use data can be collected, sent to the cloud and displayed through a web-based interface. Beyond this minimal criteria set, software packages can include a wide range of additional features such as tenant bill tracking, project management tracking, fault detection and diagnostics, public dashboards and competitions, portfolio management, control feedback to building automation systems, demand limiting, and building benchmarking and reporting.

The engagement of both building operators and building management through the use of an EIS promises a few kinds of benefits. First, EIS users become aware of their energy consumption and start to consider consumption through a more actionable metric than annual spend. Thinking about energy on an hourly or daily basis changes ones familiarity with their energy consumption patterns. Second, users start to identify specific trends and opportunities. Night time shut down (or lack thereof) jumps out of EIS hourly data visualization, while it is completely obscured in monthly data. An unusual spike in demand one afternoon begs the question, what changed? That same spike in demand wouldn't be noticed until the next month's bills are received, if at all. Finally, EIS data enables comparison and competition, both historically for a single building, and between similar facilities within a portfolio of buildings. These comparisons rely on having similar buildings in the comparison group (i.e. a campus, property portfolio, or similar lines on a production floor) rather than a preponderance of data in a statistical model, like ENERGY STAR Portfolio Manager's normalized building type-specific score.

A key point about EIS tools is that they, in and of themselves, save no energy. EIS rely on user engagement in order to save energy. Installation of an EIS will not guarantee any reduction in energy consumption – in fact, the authors heard stories while interacting with customers that sometimes these tools are installed at considerable expense and then mothballed because of a change in staffing or corporate emphasis.

While an EIS can help identify energy saving opportunities, claiming that the EIS *caused* the energy savings requires evidence that the customer *used* the EIS and acted on information provided. Unfortunately, customer engagement with EIS tools is not a given. In fact, based on literature and findings in this paper, user engagement with EIS systems may be lower than expected and used only by a small set of staff, if used at all.

For example, in the Center for Energy and Environment's (CEE) report on their Energy Intelligence program, which supported small industrial customers with EIS data-insights, 19% of their customers never logged into the EIS platform provided, and 63% logged in less than five times in the 6-9 month engagement period. However, when they compared those metrics of engagement with measure implementation, they saw no evidence that number of log-ins correlates with number of measures installed (Nelson 2017). This finding is consistent with previous studies that have shown that the amount of user engagement is not strongly correlated to achieved energy savings (Granderson, Lin, and Piette 2013). This begs the question, does a customer need to use their EIS to achieve savings, or can existence of the data and its use by a supporting third party (i.e. a utility program implementer) be enough to drive achievement?

In this paper, the authors seek to review the influence of EIS platforms on customers who participated in two different EIS programs, one offered by a utility and another offered through a research grant. The authors hypothesis is that low customer engagement resulted in long delays in EIS platform set-up, and was indicative of lower savings achieved through the process.

Background and Methodology

Data for this paper come from two different sources: a research grant and the implementation of a utility pilot program. The programmatic approaches that each effort took varied, and as such, the tools, support, and program interventions also varied.

The grant funded research was supported by the Minnesota Department of Commerce's Conservation Applied Research and Development (CARD) grant program. The project's aim focused holistically on the challenges of recommissioning outpatient medical facilities. The project scope included a task of deploying an EIS in three medical clinics. The project team explored whether the EIS could improve persistence from recommissioning measures, verify savings in real-time, and establish organizational engagement and commitment toward energy management.

The utility pilot program was designed to respond to customer interest in EIS, strategic energy management (SEM), and advanced measurement and verification (M&V) of energy savings. The program provides a rebate for a percentage of the customer's cost of installing the EIS and setting up metering. On-going support is provided through a third party consultant (Michaels Energy is one firm serving this role for customers enrolled in the program). The consultant provides support during EIS project scoping and product evaluation; measure identification and SEM plan development; and M&V of savings at the end of each year. Customers are also eligible for an operations and maintenance incentive at the end of each 12-month treatment period based on savings achieved outside of other capital-focused rebate programs.

Site Identification and EIS tool selection

In the CARD research project, the three pilot sites were identified based on past relationships with the project team and customer willingness to participate. Because of the context of the CARD research project, all three of the pilot sites were ambulatory surgical centers. The EIS platform and installation were provided at no cost to the participant. The EIS platform installed at each site was the Alerton Energy Dashboard.

In the utility pilot program, customers were identified by the utility's account managers. The program requires a minimum customer size of four GWh of annual electricity consumption. Customers were required to sign a Memorandum of Understanding, which outlined the program elements and expectations. Each participant customer was required to purchase their own EIS platform, selected from a list that was pre-approved by the utility. EIS approval for the program required demonstration of the ability to display a calculated baseline energy use regression equation and cumulative sum of savings within the software. The utility provided an incentive of up to 30% of the EIS installation and first year licensing costs, and covered all the costs of EIS and SEM consulting.

In both cases, building energy data is collected through the installation of KYZ pulse outputs installed by the customer's electric utility and natural gas utility (when appropriate). To analyze accrued savings, the project team developed a baseline energy use regression model using historical daily interval data available through a special request to the utility. Regression models and savings calculations were developed using the process laid out in the Bonneville

Power Administration Monitoring, Targeting, and Reporting (MT&R) Reference Guide (ESI EPT Team 2015).

Implementation and Customer Engagement

Implementation and customer engagement took on slightly different characteristics in each program. In both cases, the goal was to implement measures to achieve program attributable savings. In each program, success requires customers to increase their engagement in managing energy usage at their facility, and implement energy efficiency measures – presumably as a result of receiving information about their energy consumption. The differences between the programs include the methods of measure identification, on-going support offered, and the various EIS tools used for engaging customers.

In the CARD research project, measure identification was facilitated through building recommissioning studies. A consulting engineer completed these recommissioning studies for each of the three participating businesses and identified controls-based improvements to the operation of the building HVAC system. In the utility pilot program, measure identification occurs through several energy consultant walkthroughs of the facilities, where capital, recommissioning, and operations and maintenance type measures are all quantified. Customers are also responsible for identifying measures in their facility on an on-going basis. A long engagement period (a minimum of three years) makes broader measure identification possible.

In both programs, contacting customers and providing support presented challenges. Attempts were made to contact customers on a bi-monthly basis to discuss project implementation status. Responsibility for implementation rests with the customer, so the project team had limited ability to influence customer timelines or priorities. Customers in the CARD research project committed to implementing a few specific measures from their recommissioning study, and each of them progressed on implementation on their own speed. One of the three CARD participants failed to implement any measures during the study period. The utility pilot program has a more robust mechanism for engaging customers in on-going support and implementation. Customers were regularly contacted and consulting support offered to help identify measures for implementation. Participating customers can receive an incentive at the end of year for operational savings achieved that are not incentivized through any other utility programs.

The EIS tools themselves and the quality of the interface and usefulness of their information play a large role in encouraging customer use of the tool. In the case of the CARD study, the provided EIS tool lacked features like an intuitive user interface or easy comparison of performance to a model baseline that would have encouraged greater use by the facility staff. In the utility pilot program, EIS features varied greatly because customers had the ability to select their own program pre-qualified product. The types of EIS offered, and whether they are appropriate for the target program participants, is an important consideration for utility programs. Previous studies have found that in order to engage users, an EIS must provide actionable information to the user, and connect those actions to their results (Crumrine and Baker 2015). In addition, EIS users have stated that the interface needs to be simple, providing highlights and areas to focus on for energy improvement (Crowe and Leritz 2015). Different users will have different needs; what qualifies as simple and actionable information is not universal.

Findings

For this paper, the authors reviewed the customer enrollment dates for program participants who have completed installation of EIS systems through either program. Sample sizes are small for both programs, with three total participants in the CARD study and six participants who reached the point of a completed EIS installation in the utility pilot program.

The authors presume that EIS platform installations that faced more barriers and delays indicate a less engaging user experience, which might result in lower energy savings than could otherwise be achieved. Customer energy savings, as determined through each program's methodology, are included in this analysis when available. In both programs, energy savings was determined with a top-down approach, using whole building meter data and comparing that data to a historical baseline set of data, which was adjusted to account for key energy drivers, such as weather and occupancy. For a detailed description of the M&V process, refer to the Bonneville Power Administration MT&R, which served as the M&V guidance document for both programs (ESI EPT Team 2015).

Through this analysis, some limited evidence was found that a long time delay for installation may also indicate poor energy saving returns. Table 1 presents data from nine customers. The data shows that customers fell into one of two categories, those who implemented their EIS platform in about seven months, and those who took 14 months or longer. One observation is that even among the most motivated of customers, installation was never a 2-3 month proposition. This includes a textbook "perfect" participant with a specific tool in mind at the start of the utility pilot program, committed corporate leadership, staff with experience using EIS, and a motivated and engaged building engineer and controls contractor. In that case, the turn-around time was still six months, which is about double what the project team originally estimated for timing of customer EIS installation. Based on this experience, six months might be a more appropriate minimum installation period. That timeframe allows for customers to purchase a product, get pulse meter outputs installed, schedule EIS installation, and commission the system.

Table 1. EIS customer enrollment and energy savings

Facility	Customer Enrollment Date	EIS Install Complete Date	EIS Install Duration (months)	Number Measures Complete	Measure Complete Date	kWh Savings as % of Baseline	Therm Savings as % of Baseline
CARD 1	Mar-15	Oct-15	7	2	Feb-17	7%	10%
CARD 2	Mar-15	Oct-15	7	6	Mar-17	8%	6%
CARD 3	Jun-15	Nov-16	17	0	N/A	-2%	0%
Utility 1	Mar-16	Jul-17	16	1	Apr-18	11%	2%
Utility 2	Nov-16	Jan-18	14	-	In progress	2%	-
Utility 3	Jun-17	Dec-17	6	2	In progress	<1%	-
Utility 4	Jun-17	Jan-18	7	5	In progress	6%	-
Utility 5	Oct-16	Mar-18	17	-	In progress	9%	7%
Utility 6	Dec-17	May-18	5	-	In progress	-	-

It was relatively common for customers to take more than 14 months to select and commission an EIS tool. In fact, seven utility program participants who started the process within the first 23 months of the pilot but have not completed EIS installation are excluded from Table 1. These customers with long implementation times faced challenges that included: key staff leaving the organization, organizational policies requiring RFPs be issued for vendor response as opposed to sole sourcing of contracts, delays and issues with the installation of pulse outputs on meters, and staff unable to prioritize EIS installation. Aligning the project with budget cycles and competing with other funding priorities was another cause of delay for the utility program participants. There are no one-size-fits all causes for delays, but it may still be accurate to say that long delays indicate a lack of motivation and/or prioritization of the EIS tool by the facility staff or leadership.

The findings suggest that long delays will result in decreased savings; the most obvious example is the CARD participant 3. This customer took 17 months to implement their EIS, as opposed to seven months for the other two CARD participants. Installation was free in all cases, and customers needed only to provide a minimum level of engagement in the process to get utility installation of meters. CARD participant 3 was hard to engage via phone calls and meetings throughout the process and ultimately did not implement any of the recommendations for building improvements, even though they agreed to participate and implement measures at the start of the study. Conversely, the other two facilities managed to reduce gas and electric consumption by 6-10% through implementation of energy efficiency measures. CARD participant 3, who was unengaged, experienced a slight increase in electricity consumption.

The authors' observation that poor performance (e.g., incomplete installation, little to no action taken) correlates with poor engagement doesn't always bear out even within the small data set of these two programs. Only one utility program customer has reached the point of verifiable implementation (one year of post implementation data). That customer also took a long time (16 months) to implement their EIS. However, counter to the CARD participant 3 example, the data from utility customer 1 ("Utility 1" in Table 1) shows electric savings of 11% and gas savings of 2%. It's worth mentioning that this customer had a complete change of staff about 12 months after enrolling in the program, hiring a new property manager, new building engineer, and a new corporate energy manager. Once that team was on board, EIS implementation proceeded quickly.

Fast system implementation may indicate better energy savings, but is that because the EIS information was useful or because the staff were particularly motivated? Similar to other programs' results, it's not clear that high energy savings resulted from regular EIS use. None of the CARD participants reported frequently accessing their EIS platform. The two high performing customers reported only accessing the platform when accompanied by the energy consulting team. The poor performing customer (CARD participant 3) reported using the tool occasionally, because the building manager was not located at the facility the EIS monitored, and the building manager appreciated the ability to remotely check on performance. Both of the high performing building managers, in CARD facilities 1 and 2, had other tools in use to track energy use (a spreadsheet and EnergyCAP, respectively). The fact that these tools met some of their energy tracking needs might have deterred them from trying a new platform. In addition, all three of these building managers were responsible for multiple buildings, so a tool that only pulled in energy information from a single building was not as useful to them as a tool that would show their entire portfolio.

Usage rates of the tools within the utility program are not available at this time. From discussions with utility customer 1, only the corporate energy manager has access to the tool.

While he would like to train local staff to access and use the tool, it hasn't taken place yet. Therefore, the application of the EIS is focused more on remote performance evaluation and measurement and verification of specific projects (when the energy manager comes onsite). This is not an ideal situation for achieving on-going monitoring based performance improvement.

As a final point of discussion, a customer's engagement with EIS depends on the staff person assigned to work with the tool and the corporate culture in which that employee works. Throughout this process, the project team has observed that the intentions of motivated corporate-level staff have been stymied by lack of interest at the facility level, and conversely, motivated local staff limited by barriers from their company's culture or corporate management. These observations suggest that to be an engaged customer who can rapidly deploy an EIS and leverage its information, an organization needs both a supportive leadership and corporate culture, as well as buy-in from a facilities manager or engineer. Correctly identifying the presence of these characteristics can help improve implementation timing and customer engagement.

A Case Study of Real Time Performance Improvement

Given the small data set for this research, it's helpful to share an implementation case study from CARD facility 2. This case study illustrates the impact of using an EIS platform to engage customers in on-going maintenance of measures to ensure better persistence of savings. Even though this case study draws from a customer who only engaged with EIS data a few times over the course of the year, it shows the potential for facilities who use EIS on an on-going (daily or weekly) basis to elevate their energy performance.

One of the measures installed at this facility was a control sequence to reset the discharge air temperature of the HVAC unit. When facility staff were notified of a perceived high humidity problem in the building, they decided to control the cooling system discharge air temperature off the highest call for cooling, rather than the average call of all temperature zones. Since at least one zone in the building was always calling for cooling, the supply air was always at its minimum setpoint, which resulted in overcooling and reheating air to meet the space temperatures. This solved the humidity problem and occupant complaint calls ceased because the space temperature setpoints were being met.

However, the facility staff forgot to adjust the discharge air temperature reset controls back to their efficient operation (controlling off of average call for all temperature zones). As a result, the building operated inefficiently for many months, until the gas use for the building was scrutinized during a meeting to discuss measure implementation and to review the cumulative sum (CUSUM) savings graph for the facility. The natural gas CUSUM for this facility is shown in Figure 1. The inflection point in the CUSUM graph where the discharge air temperature reset control sequence was overridden can clearly be seen on June 29, 2017. In this case, the cost to the building of wasted natural gas for reheating and electricity for overcooling was $1,500 to $3,000 over three months, depending on whether the previous savings trend is extended or assumed to flatten off.

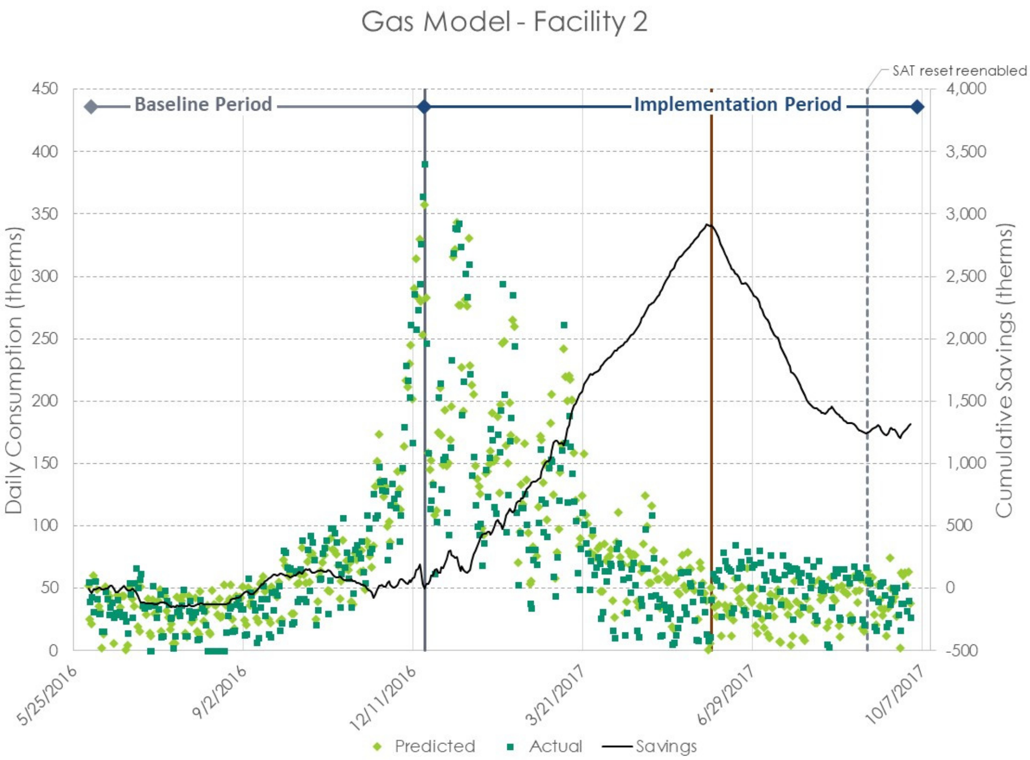

Figure 1. Natural gas CUSUM for CARD facility 2

Facility 2 is run by an experienced and capable facility manager, who knows energy use and how to efficiently manage buildings. This facility manager frequently told the project team that a major part of his job is telling a good story to corporate leadership to get them engaged in paying for energy upgrades. In order to compete for projecting funding within an organization, a facility team needs data to quantify impacts and show results of their past work. When he saw these results, he immediately knew that there was an interesting story to tell to the corporate leadership team about how to improve energy management in their facility.

Finally, one more lesson learned in this case study; no computer system replaces intervention by a human being. Without the EIS, the facility manager may have caught this specific instance of energy waste, had he been prompted to look. However, extremely busy staff don't have spare time to look for possible issues when they are dealing with many known issues. A fault detection and diagnostic type feature could potentially help – but most facility managers are uninterested in receiving hundreds of emails about the oddities of their buildings. The alternative might be more human oriented. By hiring an energy manager, or developing an energy team, and setting goals for performance and projects, staff will be reminded to take a look at energy performance and track down possible faults. These kinds of steps form the basis of strategic energy management.

Conclusion

As is often the conclusion when supporting customers with energy efficiency, a big piece of the answer rests not in specific technical solutions, but in helping customers better address energy opportunities as individuals and as a company. At the onset of the work, the authors may have postulated that access to EIS data would result in deeper engagement, but at the conclusion of this work, it seems clear that in this particular chicken or egg dilemma, support from corporate leadership and a supportive corporate culture should precede the acquisition of an EIS platform. Having some basic corporate commitments to energy efficiency, available funding, and dedicated staff will improve the customer's ability to utilize EIS data. These practices will make the installation timeline faster, improve the odds that customers succeed when implementing energy efficiency projects, and help customers leverage data from an EIS.

Given the importance of supportive corporate conditions to the success of EIS, the value of pairing an EIS installation with a Strategic Energy Management (SEM) approach to develop the customer's culture of proactive energy management cannot be overstated. While one could argue that data is necessary and essential to successful energy management, the experience in this study shows that the reverse is perhaps more true: a well-developed culture of energy management is more important than the best energy data. While the combination of SEM and EIS is powerful, the most important first step for companies to take is to engage in elementary SEM practices, like setting a goal, evaluating current practices, and assigning staff to energy management.

To further explore some of the specific challenges encountered by customers in these two programs, beyond the lack of a SEM program, the authors have assembled a list of additional challenges and potential solutions in Table 2.

Table 2. Challenges and potential solutions to EIS installation and customer onboarding

Challenge	**Potential Solution**
Customer Data Security Concerns	Many organizations are leery of granting external access to their network. Consider utilizing a dedicated network, such as cellular signals for EIS integration with the cloud.
Utility Meter Pulse Output Installation Delays	Utility meter shops can often be backlogged up to two months. Start the request for a pulse output through utility account managers or other channels as soon as possible.
Inadequate EIS Toolsets	Have a clear understanding of what is desired from the EIS. If features do not exist but are promised in the future, get those agreements in writing.
Lack of Engagement with EIS	In designing utility programs, do not attempt to shoehorn customers into an EIS program if they are not ready to utilize the data. Ideally, interested customers should have strategic energy management processes in place before pursuing an EIS.
Staff Turnover	Staff turnover may be inevitable and delays unavoidable, but an accessible third party consultant can bring the new team up to speed.
Competing Energy Tracking Tools	Ensure that the EIS offers solutions beyond existing energy tracking, and present those to

	engaged facility staff to gain buy-in before installation.
Varying Levels of Commitment Throughout Organization	Ensure that corporate-level staff down through site facility and energy personnel are onboard and on the same page before pursuing the implementation of an EIS.
Budgeting Delays or Lack of Funding	Ensure customers get budget approval for the EIS as early as possible in the process, ideally during the customer commitment phase.

Identifying these challenges and building solutions into program design could help utilities offer more successful, and more cost-effective, EIS programs. However, simply eliminating barriers to EIS on-boarding (product selection and installation) doesn't necessarily eliminate barriers to broader customer engagement or the successful use of EIS data. Looking holistically at EIS programs, customer and program success depend on engaging customers both in their use of the EIS tool, with appropriate features, reliability and training, and in the process of managing energy strategically as an organization, through goals, corporate leadership, staffing, metrics, and funding.

While the evidence does not clearly indicate that more frequent user log-ins result in higher energy savings, the authors find evidence that does point toward higher user engagement (as measured through elements of strategic energy management) resulting in better energy performance in buildings. So as utilities, building managers, product vendors, and others engage with customers throughout the process of installing an EIS, it's helpful to remember to go back to the basics of SEM practices. Customers will be more satisfied and experience better results if they take time to build a supportive culture around energy management first, instead of chasing new tools and piling on data.

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