“Better data drives better decision-making” is an adage popular among professionals in the public sector. From geographic information system–driven asset management to supervisory control and data acquisition plant operations, utility managers also understand that being equipped with the right data enables an organization to make more informed decisions, which translates to improved service and decreased costs for customers. But in the human resources (HR) department, where can a manager turn to find relevant data? Ideally these data would be readily available and not require the installation of complicated and costly information technology systems. And, critically, how can data be used to drive the organization’s workforce strategy?

This article answers both questions by introducing the Kaplan–Meier estimator, or KM curve, a statistical method that HR professionals can use to create a single graphic to illustrate employee turnover using hire and termination dates. This article provides the background motivation for the City of Houston’s Public Utilities Division. The analysis used historical employee rosters for the period from 2007 to 2016 to determine which groups of utility employees contribute most to turnover. Findings indicate that the majority of employees who left the organization did so either during their first seven years of employment or near their 20-year work anniversary. The resulting workforce plan includes recommendations for targeted intervention activities for these two groups. Other utilities can similarly apply the KM curve to develop an understanding of their patterns of turnover and to identify opportunities to increase employee retention.

**BACKGROUND**

The authors were tasked with developing a strategic workforce plan for the Houston PUD. The workforce plan would recommend action items to help the city recruit and retain staff more effectively. The authors realized that prior to making any specific recommendations, they first had to understand the specific challenges facing the utility in employee recruitment and retention. They would then have to communicate these challenges to the appropriate management teams in order to foster the executive support necessary for the plan’s implementation. Thus it was crucial that the workforce plan provide a detailed understanding of turnover within the organization and discuss how the proposed recommendations would address the specific concerns identified.

The authors began by taking AWWA’s national benchmarking performance indicators and comparing them with the division’s own turnover rate. Data from a recent AWWA benchmarking survey (Mercer & Anderson 2011) showed that the median rate of turnover for utilities serving populations over 500,000 was 6.46% while the rate for utilities in the southern region was 8.07%. By the same measure, Houston’s utility turnover rate was 9.07%, which showed that Houston was slightly underperforming compared with other municipalities in the same region (Table 1). However, these data were of limited use in developing the workforce plan. While the data showed that the
Houston utility had room for improvement compared with similar utilities, the numbers did not suggest any specific course of action the utility could take to reduce its employee turnover rate. As previously noted, the authors wanted to gain a detailed understanding of why turnover was high and then use that understanding to develop recommendations targeted at lowering the utility’s turnover. Specifically, the authors sought to answer the following questions:

- What groups of employees contribute the most to turnover?
- In response, what strategies could be used to reduce turnover by targeting the identified groups?

**THE KM CURVE**

The authors turned to medical research literature from the field of oncology and adapted the KM curve (Kaplan & Meier 1958). To illustrate the KM curve’s application to a utility, consider the following example.

“Main Street” is a small utility; over the last nine years, four people have worked at and left the organization. Table 2 lists the employees, their start and end dates, and their tenures. The start and end dates correspond to an employee’s hire date and termination date according to HR records. Tenure is calculated as the time that passes between the start and end dates. This information is sufficient to calculate the KM curve and provide a picture of the utility’s patterns of turnover.

Figure 1 presents the information from Table 2 visually. Using this graph, some basic observations can be made. Christina’s tenure is significantly longer than the other employees’, and Don’s is shorter than the utility’s average. While a fairly complete understanding of turnover at Main Street is already evident, one can imagine this graphic quickly becoming unwieldy when hundreds or even thousands of employees are included.

Figure 2 sorts the information from Figure 1 in a more organized fashion, first by sorting the employees along the left axis by tenure from shortest to longest. Figure 2 then superimposes a line across the tops of each of the tenure bars and connects them. This is a graphical derivation of the KM curve. At any point along the horizontal (x-) axis, the corresponding reading shows the percentage of employees who reached at least that level of tenure. For example, all Main Street employees reached at least one year of tenure; so, from zero to one year, the graph reads 100%. This percentage decreases as tenure increases. Christina is the only one of the four employees to reach more than four years of tenure, so the reading from four to nine years is 25%. Therefore, at any point along the x-axis, the number of years can be matched with the corresponding percentage of departed employees whose tenure reached at least that length.

The simplicity of this graph should be of particular interest to utility leaders. The KM curve is able to paint a succinct picture that describes turnover within an organization of any size. This is achieved using data no more complex than historical employee rosters—hire dates and termination dates—which all HR departments have readily available.

**RESULTS FOR HOUSTON’S PUBLIC UTILITY**

To construct Houston PUD’s KM curve, the authors first used R, an open source statistical software (R Core Team 2015) to compile monthly rosters from 2007 to 2016 and

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**TABLE 1** Employee turnover rates for Houston and AWWA benchmark cities median

<table>
<thead>
<tr>
<th>Location</th>
<th>Turnover Rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Houston Public Utilities Division</td>
<td>9.07</td>
</tr>
<tr>
<td>AWWA benchmark population &gt; 500,000</td>
<td>6.46</td>
</tr>
<tr>
<td>AWWA benchmark region 3: South</td>
<td>8.07</td>
</tr>
</tbody>
</table>

Source: Mercer & Anderson 2011

**TABLE 2** Example roster for Main Street utility

<table>
<thead>
<tr>
<th>Employee</th>
<th>Start Date</th>
<th>End Date</th>
<th>Tenure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greg</td>
<td>1/1/2008</td>
<td>1/1/2012</td>
<td>4 years</td>
</tr>
<tr>
<td>Christina</td>
<td>1/1/2007</td>
<td>1/1/2016</td>
<td>9 years</td>
</tr>
<tr>
<td>Eric</td>
<td>1/1/2012</td>
<td>1/1/2015</td>
<td>3 years</td>
</tr>
<tr>
<td>Don</td>
<td>1/1/2009</td>
<td>1/1/2010</td>
<td>1 year</td>
</tr>
</tbody>
</table>

**FIGURE 1** Main Street utility tenure graph

**FIGURE 2** KM curve for Main Street utility

KM curve—Kaplan–Meier estimator
then extracted the identification number, hire date, and termination date for each employee. Only employees with both a hire date and termination date are included in this analysis. This method excludes current employees, since their termination dates are not yet known. The start date was subtracted from the termination date to determine each employee’s tenure. Then, this information was fitted into the KM curve format (per the Main Street example). The analysis was conducted using the following R software packages: xlsx (Dragulescu 2014), plyr (Wickham 2011), survival (Therneau 2015, Therneau & Grambsch 2000), and ggplot2 (Wickham 2009).

Figure 3 shows the results when the KM curve was applied to the City of Houston’s historical employee rosters. During the study period, the rosters showed 854 employees departed the organization. Just as with the simpler Main Street example, the tenures for these 854 employees were calculated and then ordered from shortest to longest tenure. The KM curve was mapped over the individual employee bars, and the resulting curve was reproduced in Figure 3.

Just as in the Main Street example, the graph for the Houston PUD can be interpreted by following a tenure point vertically up to the curve. The corresponding percentage denotes the percentage of departed employees whose tenure reached or exceeded that point. The KM curve begins at zero years with 100% of employees and gradually decreases as the value for tenure increases. For example, the curve drops below 50% when tenure reaches seven years. This illustrates that 50% of employees who departed Houston PUD between 2007 and 2016 did so by their seven-year work anniversary.

Of particular interest are the areas where the curve drops off the steepest. Mathematically, this corresponds to the set of points on the KM curve at which the derivative falls below the average derivative value across the entire function. This represents the tenure points at which departing employees are contributing the most to turnover. The two areas of greatest concern for Houston PUD were employees whose tenure ranged from zero to seven years of service, and from 19.5 to 24 years of service.

Finally, the authors had attained concrete data on particular areas where the utility could most strengthen its retention strategy. Having identified the two groups that contributed the most to turnover at Houston PUD in recent years, the authors were able to develop a workforce plan specifically targeting these employees.

**DECISION-MAKING AT HOUSTON PUD**

The KM curve highlighted two unique groups of employees who required particular attention in the workforce plan for Houston PUD. The first group was straightforward to identify. Employees with the least tenure at the organization are the new and recent hires. These would also tend to be the youngest employees in the organization, with a significant proportion of them belonging to the millennial generation. Correspondingly, part of the authors’ workforce recommendations were tailored toward addressing high turnover in this group.

The KM curve for Houston’s utility (Figure 4) then levels off before dropping steeply beginning at near the 20-year mark. The reason for the sharp drop-off near this specific point is believed to be due to experienced employees nearing the vesting of their municipal pensions. Armed with this knowledge, specific programs could be developed and recommended in response. This knowledge enabled the team to develop programs tailored to the specific needs of these two groups: new employees and employees nearing retirement.

**Retention strategies for new employees (tenure: zero to seven years).** In previous years, one of the selling points to municipal employment was financial: government employment famously offered the prospect of a stable job, good benefits, and a generous pension plan. Budget...
restrictions in recent years have limited the ability for cities to recruit new talent using monetary incentives alone. Successful retention strategies for new employees, then, are those that both create a workplace that is more responsive to employee needs and that minimize the financial obligations placed on the city.

The workforce plan for Houston PUD strove to address this by recommending an alignment between the interests of young professionals and the organization. One of the authors drew from his own experience starting as an intern at Houston four years prior and progressively moving up to a role today in which he supervises other employees and participates in executive decision-making meetings. His experience is typical of other ambitious young employees at Houston. Talented young professionals seek upward mobility and, when provided a clear path of progression, will work hard to pursue it. Conversely, should employees observe that seniority is the only route to career progression, they will likely look to other organizations or even the private sector to seek the opportunity to advance in their careers. By actively providing well-defined paths of progression, utilities should be able to increase retention rates of young professionals while grooming the next generation of leaders.

Granting employees flexibility to learn within the organization is another strategy the plan identified to help increase retention at the utility. Several recent hires at Houston PUD actively sought training opportunities to learn areas of the business once they had gained a grasp of their own responsibilities. For example, one young professional analyst at the utility voluntarily attended plant operator certification training to gain more context for the data she was analyzing. Open-ended educational opportunities like these increase employee engagement, which is a key factor in retaining recent hires (who may otherwise tire of their positions and seek professional challenges outside the organization). Such programs have the added benefit of improving the skills of the organization’s workforce—well-rounded employees build robust professional networks outside of their immediate business silo, can be rotated throughout the organization as needs dictate, and bring to their daily responsibilities a better understanding of how the organization’s parts cooperate as a whole.

Retention strategies for employees awaiting retirement (tenure: 19.5+ years). Some (though certainly not all) municipal employees appear to disengage toward the end of their careers. The focus shifts from serving the citizens to working enough days to become fully vested in a pension program. The workforce plan recommended for employees at this career stage is twofold: first, increase engagement so that employees can be positive contributors to the workforce and the culture and second, manage the transfer of institutional knowledge from employees to the next generation.

One recommendation in the workforce plan to maximize the contribution of experienced employees is that the utility invest in cross-training and continued education. Some employees at Houston PUD have performed the same job function for several decades, and they often display disinterest or disengagement at work. Cross-training gives employees who are bored with mundane routines the chance to be refreshed and reengaged in their profession. Broader continuing education efforts, like the utility’s recent push to train field workers on the use of mobile devices, can similarly engage employees while providing them with skills that may be useful in other parts of their lives. In parallel, the skills of an organization’s workforce can be continually updated to face the evolving challenges of a modern utility.

Another strategy identified in the workforce plan is developing an employee mentorship program. Experienced employees at the utility had previously expressed concern that they no longer felt like valued members of the organization. To address this, older employees may be paired with younger ones, so they can pass along the insights gained from their years of service. This increases engagement by demonstrating to experienced employees that they are wanted, valued, and respected by their colleagues. A mentorship plan serves a second purpose of informally facilitating the transfer of institutional knowledge to the next generation.

**BEST PRACTICES FOR UTILITY PROFESSIONALS**

The KM curve played a key role in guiding the development of the Houston PUD workforce plan. In particular, the graph can be used internally to help guide utility leaders and HR professionals in developing a data-driven response to turnover by targeting specific areas within their organizations. The KM curve can also be used externally, as part of a presentation to political leaders in seeking justification for upcoming decisions. Municipal utilities are familiar with the series of approvals and permissions required before any major change can be undertaken within their organizations (especially decisions that require increased budgets). By presenting the KM curve to elected officials and department heads, those stakeholders can be invited into the process of deciding a course of action in responding to turnover. There will be less need to justify new programs or major initiatives because the justification may be illustrated by a single graphic.

Utility leaders and HR analysts should consider taking the simple step of drawing the KM curve for their organizations, and to compare their results with those of the Houston PUD. Applying the same analysis at a different utility will point out that organization’s specific areas of concern, highlighting which groups of employees are contributing the most to turnover and who would benefit from a targeted turnover response plan.
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