Leveraging Metrics to Improve Project Performance

The effective use of metrics is essential to project management (PM) success. As Kerzner explained, "the ultimate purpose of metrics… [is] to provide the right information to the right person at the right time, using the correct media and in a cost-effective manner (2017, p. ix). Kerzner (2017) emphasized that insufficient or ineffective metrics cannot sufficiently aid in understanding project performance. Moreover, Kerzner wrote that failures in metric management are now recognized "as perhaps the single most important cause" of project failure (2017, p. x). Consequently, project managers must employ metrics effectively to drive project success.

Using Metrics to Effectively Manage the Triple Constraints: Time, Cost, and Scope

Kerzner (2017) wrote that proper use of metrics is essential to capable PM, explaining that "if it cannot be measured, then it cannot be managed. What gets measured gets done" (p. 91). Shell (2014) noted that project managers can use metrics to guide tactical decisions to improve overall project health. As well, metrics are used to establish and communicate project status, educate staff, forecast, and predict issues (Shell, 2014). The PMBOK Guide® (Project Management Institute (PMI), 2017) and Kerzner (2017) wrote that project performance metrics traditionally revolved around the "triple constraints" (cost, time, and quality or scope). Shell (2014) identified common project metrics for the triple constraints: actual costs versus planned costs, project progress against the schedule, and adherence to quality standards. For example, the list of milestones and their due dates, along with indicators for completion and acceptance, can be tracked to assess project progress against the schedule. Adherence to quality standards may be measured using defect rates or customer satisfaction rates. Additionally, scope changes may be measured as a ratio of the current project size to the original project size.

Methods and systems have been developed to simplify tracking and reporting for the triple constraints. For example, Earned Value Analysis (EVA) and the Earned Value Measurement System (EVMS) are well regarded and frequently used to determine project status in terms of cost and time (Kerzner, 2017). The EVMS functions as an early warning system, giving project managers time to make adjustments before variances in time or costs are excessive. The EVMS also includes forecasting calculations for the estimated cost at completion and the anticipated completion date based on progress to-date.

Defining Metrics Effectively

Shell (2014) noted that data volume can be overwhelming, a condition which makes it critical that data be transformed into information that can then be used as metrics. Shell (2014) added, "As we transform data into metrics, metrics are used to understand, control, evaluate, and predict." While metrics can provide significant benefits, Kerzner (2017) identified three broad categories of risks inherent in using metrics. First, identification risks are associated with having vague metrics, excessive metrics, and poor quality information. Second, measurement risks are related to unclear or inconsistent measurement techniques or expensive measurements. Third, display risks are associated with poorly understood, poorly designed, and cluttered displays.

Metrics help drive project success by tracking and reporting the strength of critical success factors (CSFs) and success criteria. CSFs identify focused areas "that contribute to achieving project success" (Todorovic, Petrovic, Mihic, Obradovic & Bushuyev, 2015, p. 774). Kerzner (2017) explained that, while CSFs are typically broad and difficult to track, metrics and key performance indicators (KPIs) are specific, and consequently measurable and reportable. Metrics can be identified, tracked, and reported to indicate the level to which the project is

achieving each CSF. Todorovic et al. (2015) explored the relationship between CSFs and project success, noting that CSFs contribute to project success, while success criteria are used to evaluate a project's success. Todorovic et al. (2015) noted that KPIs are the factors that makeup success criteria, determining project success. Considering KPIs, Guo (2019) wrote that success measures such as product satisfaction and organizational effectiveness and CSFs such as senior management support and project manager skills are, at times, essential.

Kivilä, Martinsuo, and Vuorinen (2017) studied a road tunnel construction project to understand how the key metrics were selected to drive the project's success. The project used an incentive model that included several metrics: the project cost, exceptional events, and the KPI set, which measured the schedule, work safety, tunnel usability, and public image. The financial incentive was based on the KPI targets, and its amount was affected by achieving the target cost as well as by exceptional incidents (positive or negative). Kivilä et al. (2017) emphasized the importance of getting all stakeholders in agreement with regard to success criteria and then using metrics to track success criteria. This agreement and close monitoring contributed to the success of the project. The case study that Kivilä et al. (2017) described was aligned with expert recommendations to carefully choose CSFs and success criteria and then identify metrics and KPIs that can effectively track and report progress towards those factors and criteria. The case study illustrated how the effective use of metrics can drive project success.

Key Performance Indicators

Key performance indicators (KPIs) are metrics that are broadly used in project management as a means by which to monitor the project's alignment with its critical success factors (CSFs) and success criteria. Badawy, Abd El-Aziz, Idress, Hefny, and Hossam (2016)

identified a multi-step process for developing KPIs. First, identify the issue that requires addressing. Next, quantitatively describe how results would preferably look (*e.g.*, reduce the defective rate from 7% to 3%). Third, develop a process to achieve the desired results. Fourth, identify KPIs, sequentially focusing on effectiveness KPIs (meeting the benchmark), capacity KPIs, strategic KPIs, product KPIs, and input KPIs. Finally, select the best-fit KPIs, carefully documenting and sharing them. As Badawy et al. (2016) explained, it is critical to carefully choose KPIs, as they enable management to probe with effective questions. All essential stakeholder perspectives and key issues must be considered when designing KPIs. Both Badawy et al. (2016) and Kerzner (2017) emphasized the importance of having no more KPIs than necessary, as having too many KPIs makes it challenging to focus on the most important elements for project success.

Staron, Niesel, and Bauman (2018) explained that KPIs can be process- or performance-based, and that each KPI has an owner and an interpretation, and it is linked to a corporate strategy. Staron et al. (2018) noted that, while KPIs are widely considered critical in monitoring project progress, few studies have explored the specifics of how they should be used in practice (*e.g.*, how many KPIs should be selected, how frequently they should be reported, and how they should be calculated). Staron et al. (2018) wrote that continuously monitoring and reporting KPIs requires resources and may scale poorly as more KPIs are used. They also noted that, when several KPIs are identified, they are more likely to monitor similar or related issues. Staron et al. (2018) studied the use of KPIs in twelve projects within a single vehicle manufacturing organization over a six-month period to assess best practices with regard to KPI selection, monitoring, and reporting. Staron et al. (2018) found that deliverable completion was

typically measured with a KPI reflecting the number of completed activities in the early stages of a project, while it shifted to a KPI represented completed product elements in the late stages of a project, indicating the product's readiness for release. For example, the number of requirements reviewed may be significant early on, while the number of defects may be important later in the project. Staron et al. (2018) reported that several project managers encountered issues with synchronous and asynchronous data; in particular, they often doubted when exactly data was recorded for a given slice of KPI data. That doubt made interpretation of KPI metric data more challenging. The projects Staron et al. (2018) studied used a large number of KPIs (252 to 552 per project); consequently, many KPIs were interrelated, at times creating confusion.

Visual Project Management Tools

Williams (2015) noted that PM is a data-rich discipline, with hundreds of project data points that are tracked, transformed, assessed, and communicated. For example, projects typically include data related to human and capital resource expenses, task and activity lists, performance metrics, cost-benefit analysis, data trends, schedules, and so on. Data visualization tools and techniques are useful in helping decision-makers to process that data more efficiently and effectively since people perceive visual patterns far more quickly than they process tabular data (Williams, 2015). The field of PM has traditionally used numerous visualizations, including Gantt charts, work breakdown structures (WBS), project stakeholder organization charts, project team calendars, and others. For example, Grossman, Banavage, Kavanagh, Reyes, and Huntsinger (2016) reported that the University of Virginia Medical Center's clinical cancer team used a modified vertical value stream map as a visual PM tool to improve engagement, collaboration, and accountability, clarify priorities and goals, and complete projects successfully.

Today's computer-based visual PM tools provide a wide array of visualizations, such as real-time project status and status tracking and real-time issues and resolutions (Williams, 2015). Moreover, traditionally, data was communicated by "pushing" (*e.g.*sending out reports), but today's visual PM tools allow users to "pull" information, accessing real-time information when they want to see it (Williams, 2015). Williams (2015) identified numerous visual thinking tools that are useful in PM, including process mapping, storyboarding, and root cause analysis. As well, Williams (2015) identified numerous visual reporting tools for PM, including earned value analysis (EVA) charts, dashboards, burn down charts, and road maps.

Dashboards

When implemented well, dashboards can serve as powerful communication tools, quickly and clearly sharing essential performance data in a way that is easily assimilated (Kerzner, 2017). Dashboards are especially helpful in showing "big picture" data for KPIs. Dashboards serve two primary purposes: (1) to help users to identify issues and make decisions and (2) to provide reporting by communicating status updates (Kerzner, 2017). Kerzner (2017) noted that dashboards must be tailored to their audiences, showing viewers just the data they need. Projects often require different dashboards for different user roles (Kerzner, 2017). As well, a few dashboards may be necessary to fully share status with a given user (Kerzner, 2017).

Kerzner (2017) explained that it is essential that the dashboard designer understand the users' needs as well as their hopes for the solutions the dashboard will deliver when developing a dashboard. Along those lines, it is essential to understand the user's key metrics and KPIs. Once the required metrics are understood, before building out dashboards, it is critical to understand how the data can be accessed (Kerzner, 2017). Organizations often use multiple systems to track

and store data, and so dashboards often need to show content from multiple systems. In fact, some KPIs may be created by synthesizing data across systems. Next, it is vital to know how frequently data will need to be accessed; strategic dashboards may need only monthly data updates, while operational dashboards may require updates every few minutes. While dashboards appear in numerous forms, Kerzner (2017) outlined three broad categories of performance dashboards: operational, tactical, and strategic dashboards. The target audience and dashboard purpose dictate the most appropriate type of dashboard.

Visual Project Management Tools

Duffy (2019) reviewed PM information systems (PMIS) and noted that most PM services are hosted online and support project collaboration and real-time access to project data. For example, most let users see who is assigned to which tasks, and most provide Gannt charts to show how tasks are interrelated. Duffy (2019) noted that visual PM tools vary in their support for managing people, materials, and expenses visually. For example, Duffy (2019) wrote, high-end PM apps offer automatic rescheduling of tasks that are dependent on other tasks with slipped deadlines, integrated invoicing and billing, and support for work re-balancing across team members. PM software also varies in its support for role-based security (Duffy, 2019).

Case Studies

Project Success Achieved through Effective Use of Metrics

Van den Berg (2012) presented a case study of the Mozambique Banana Plantation Project. The three-year project was developed to grow high-quality bananas for the European market. International marketers and distributors planned to distribute 20 million cartons of African-grown bananas annually to Europe during a time when Europe imposed high tariffs on

Latin American bananas. They contracted the Mozambique Banana Plantation Project to develop 3,000 hectares of banana plantations with substantial supportive infrastructure. A conglomerate of companies and investment houses funded the effort. The project was initially valued at US$60 million. It was anticipated that investors would provide the venture capital and that the plantation would generate the remaining funding required to complete the project. According to the plan, the leading marketer would identify the quality standards required and provide consultation to the growers. The bananas would be sold for no more than US$4.50 per carton to the marketers and distributors, who would then sell each carton for US$6.50.

The project was behind schedule nearly from the start due to several challenges, including a remote, difficult-to-access work site, endemic malaria and malnutrition (which contributed to low productivity), a low-skilled workforce, and significant communication issues. The distributor insisted that a formally-trained project manager be involved, and so a certified Project Management Professional (PMP)® consulted for the first two months. After, the project manager left and a general manager without PM expertise lead the project for its duration.

The project was planned in three phases, delivering 750 hectares by end of year (EOY) 2009, 1,750 hectares by EOY 2010, and 3,000 hectares by EOY 2011. By mid-2009, 270 hectares were planned, but only 191 hectares were planted. This metric showed that the project's schedule was in jeopardy. To address the delay, banana trees were hurriedly planted without adequate cableways. Unfortunately, the procurement of cableways was a CSF to guard banana quality. The alert raised by the metric tracking the cableways CSF suggested bananas could be easily damaged on their way to the packing stations. As well, project cost metrics indicated significant concerns, as actual costs were 25% of the budget, while earned value was only 12%.

After reviewing the troublesome project metrics, investors directed the project steering committee to appoint a consultancy to recover the project. The recovery team first audited the project and analyzed its problems. It found that a poorly defined scope with an incomplete list of deliverables resulted in an incomplete budget and schedule. As well, it noted poorly planned resources and numerous unrecognized warning signs. Moreover, project controls were not defined. Since the budget was not well developed, the project manager lacked control over costs.

The consultancy made adjustments that got the project back on schedule within two months. Even so, once they looked more deeply at costs, they realized that the business case was fundamentally flawed due to erroneous assumptions. For the project to yield profit, either the cost per carton would have to be reduced (also reducing quality - a condition the buyer rejected), or the buyer would have to pay more (which the buyer also rejected, as the contract was signed). The conglomerate did not want to cancel the project, as the project had a deep socioeconomic impact on the local economy, and its cancellation could have resulted in political upheaval.

A critical risk event occurred during the life of the project. In the original business case, the European Union (EU) would pay well for high-quality bananas, since it had a high import tariff on Latin American bananas. However, while the project was underway, the EU lifted the import tariff, which eliminated the original market driver for the project. Europe no longer needed high-quality African bananas, and the contract was canceled. Fortunately, the project team found that there was a market for lower-quality bananas in the Middle East. These lower quality bananas could be grown for US$4.90 per carton and sold for US$8.20. The lower market demand meant only 1,200 hectares were needed, and so less infrastructure was required. As well,

the lower quality meant more bananas could be grown per hectare. The project scope, budget, timeline, and deliverables were dramatically adjusted, and the project finished successfully.

In the Mozambique Banana Plantation Project, metrics were effectively used to trigger the need for project recovery efforts. Those efforts studied metrics for the project more closely and found that it was fundamentally flawed. Even so, they were able to use metrics to identify that the project could be completed successfully with fundamental adjustments.

Case Study: Developing Performance Indicators

Personal, Guerrero, Garcia, Peña, and Leon (2014) researched creating a key performance indicator to assess success with regard to Smart Grid projects. Personal et al. (2014) noted that the success of Smart Grid projects is difficult to accurately measure due to their multidisciplinary nature. That is, the component technology systems require advanced interoperability, and so success is best measured from an overall standpoint rather than by merely using metrics reflecting the performance of the component parts. Personal et al. (2014) explained that the proposed KPI was utilized in the Smartcity Malaga (SMCT) project in Malaga city, Spain. The project had among its goals increasing energy savings and renewable energy use each by 20% and reducing CO2 emissions by 20% below 1990 levels. To track performance, the project utilized a data acquisition system (DAS) to gather real-time information and store it in a database that used the Common Information Model (CIM) (a standard in power distribution projects). ISockets and iNodes were used for communication.

Personal et al. (2014) explained that a computational tool was necessary to assess how well the data complied with the project goals. For the computation of KPIs, they leveraged several key metrics, including the efficiency of the power system, efficiency of power

consumption, increase of renewable energy use, reduction of emissions, improvement of power quality, extension of service life of facilities, and reduction of breakdown and maintenance costs. Personal et al. (2014) proposed using business intelligence (BI) tools such as balanced scorecards (BSCs) to understand the metrics. Personal et al. (2014) created a dashboard with gauges showing alignment with each of the three primary goals, as well as line graphs showing historical trends. Their recommended KPIs also reflected secondary objectives, including reliability, safety, and cost reduction. Using calculations involving numerous data inputs, Personal et al. (2014) derived five KPIs: reduction in overall demand, reduction in peak demand, reduction in CO2 emissions, improvement in zonal quality, and extension of service life of transformers.

Case Study: Using Value-Based Project Management Metrics

Kerzner (2017) contrasted business metrics with PM metrics. The PMBOK Guide® (PMI, 2017) and Kerzner (2017) acknowledged that project performance metrics traditionally revolved around the triple constraints. While these PM measures remain important, additional metrics are necessary to more fully understand a project's performance, including its business value. Consequently, projects must also include metrics that measure and determine project success in terms of how its product or service is contributing value to the organization.

Levin (2015) agreed that project managers must track project success using metrics beyond the traditional triple constraints and customer satisfaction to include business value and contribution to strategic goals. Consequently, Levin (2015) provided guidelines for developing value-based PM metrics. First, Levin (2015) wrote, it is essential to identify and categorize anticipated benefits using a four-quadrant matrix (*e.g.*, financial and non-financial, tangible and intangible). He noted that intangible benefits typically need to be translated into quantifiable

measures (such as with surveys). Next, Levin (2015) recommended that the project manager, with stakeholders, analyze the benefits and prepare a benefits realization plan so that benefit costs and timelines can be understood. As well, benefits realization criteria should be established and associated metrics should be developed. Finally, Levin (2015) emphasized the importance of planning for hand off once the project is completed, ensuring benefits are sustained. Levin (2015) noted the importance of having a strong communication plan throughout so that everyone, from project team members to senior executives and influential stakeholders, understands the benefits realization plan and its status. Further, the benefits champion should encourage active communication, "welcoming new ideas as a way to promote buy-in at all levels" (Levin, 2015).

Alderton (2014) explained that a corporate social responsibility (CSR) project is designed to benefit "both its targeted cause and its sponsoring organization." Of course, such benefits must be measured with metrics. Alderton (2014) noted that only 38% of CEOs believe they can quantify the value of their CSR initiatives accurately and 37% of CEOs acknowledge that the lack of clear metrics limits progress toward CSR goals. Alderton (2014) described the Amazon Program, a CSR initiative Brazil's largest cosmetics company, Natura, launched to promote socio-biodiversity in the Amazon. When engaging in projects, Natura is careful to identify quantitative metrics to track progress towards its sustainability goals. For example, in the Amazon Program, Natura tracked and reported metrics such as the number of local suppliers involved and the percentage of ingredients sourced locally in order to work towards its goal to increase Natura's purchases of sustainable raw Amazonian materials (Alderton, 2014).

Dalmarco, Hamza, and Aoqui (2015) also explored Natura's sustainable approach, noting that sustainability has been a core company value since its inception. In Natura's SOU project,

the company measured its alignment with its strategic goal for sustainability through reducing its use of raw materials (16% less overall, with a 16% reduction in greenhouse gas emissions) and packaging (70% less plastic, with a 60% reduction in greenhouse gas emissions). Dalmarco et al. (2014) noted that Natura has been widely recognized for its work incorporating values goals in its projects; in 2013, the Corporate Knights ranked Natura second in the world for sustainable companies, and, in 2014, Forbes magazine ranked Natura as the tenth most innovative company in the world. As well, the United Nations Organisation awarded Natura its 2019 UN Global Climate Action Award (Natura, 2019).

Flipse, van Der Sanden, and Osseweijer (2014) wrote that policymakers encourage innovators to integrate Social and Ethical Aspects (SEAs) into Research and Development (R&D) projects. So, they explored the implementation of SEA KPIs in an R&D project. Flipse et al. (2014) wrote that researchers in academia and industry often fail to identify SEA KPIs explicitly. However, Flipse et al. (2014) noted that integrating SEA KPIs into a research project has positive effects on innovation (due to guiding researchers in clarifying their thinking, enhancing their decision-making and setting improved research goals and priorities). As well, Flipse et al. (2014) noted that integrating SEA KPIs has positive social effects, including making the process more democratic, preventing public backlash, and making more socially robust innovations.

Flipse et al. (2014) developed KPIs for a set of food-related projects at NIZO food research B.V., a Dutch contract research company. They used the Midstream Modulation (MM) method and added an Embedded Humanist (EH) to five mm-group projects to regularly interact with researchers in their laboratories for twelve weeks, gradually broadening research decisions

to include more social and ethical perspectives (Flipse et al., 2014). A comparison group (c-group) of five projects did not use an EH. All projects used a modified version of the Wageningen Innovation Assessment Toolkit (WIAT), which measures success in R&D projects by assessing "project performance based on KPIs relating to innovativeness, project newness, upstream and downstream resources, team communication, innovation potential, innovation process quality and market competition" (Flipse et al., 2014, p. 186). The team added socially relevant KPIs associated with food technology (such as health and sustainability) (Flipse et al., 2014). Flipse et al. (2014) reported that participants found the use of SEAs to be functional and useful; as well, SEA use resulted in measurably improved KPI scores.

Discussion

The field of project management is deeply dependent on the effective use of metrics in order to drive project success. To reiterate, Kerzner (2017) wrote, "if it cannot be measured, then it cannot be managed. What gets measured gets done" (p. 91). The considerations that go into selecting vital success-related aspects of the project - both the critical success factors (describing elements deemed necessary for project success), as well as success criteria (elements identifying project success) - are essential. After identifying these key elements, it is vital to identify metrics that can effectively measure achievement towards CSFs and success criteria. By tracking the essential metrics and KPIs, the project manager understands how well the project is performing against established measures. As well, variances between actual and planned values inform the project manager where the project is falling behind, giving the project manager the insight necessary to effect positive changes to realign the project with its objectives. By reporting

metrics and KPIs, the project manager effectively communicates the project status to the project team and project stakeholders, ensuring that everyone understands project performance.

Recommendations

Project success depends on the effective use of metrics. First, the project manager and key stakeholders must thoroughly consider and select CSFs and success criteria, thinking beyond the traditional triple constraints to include key business values. It may be necessary to review organizational strategic objectives when setting success criteria to ensure the project's alignment with the organization's vision. Next, metrics and KPIs must be carefully selected to effectively reflect the project's performance with regard to the identified CSFs and success criteria. Some metrics (such as EVA measures) may be readily available, depending on the PMIS in use. Other metrics may require careful consideration and calculations using data from a variety of sources. It is helpful to present metrics visually, such as with a dashboard. When doing so, it is important to include context (such as baseline or target numbers, as well as historical trending data) in order to maximize the dashboard's utility.

Conclusion

By employing metrics effectively, project managers are able to understand and communicate their projects' status and performance. As well, accurate, timely information makes it easier for decision-makers to make adjustments when projects are out of alignment with objectives and goals, increasing the likelihood of project success.

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