Business Intelligence Support For Project Management

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BUSINESS INTELLIGENCE SUPPORT FOR PROJECT MANAGEMENT

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Abstract: *With respect to the project management framework, a project live cycle consists of phases like: initiation, planning, execution, monitoring & control and closing. Monitoring implies measuring the progress and performance of the project during its execution and communicating the status. Actual performance is compared with the planned one. Therefore, a minimal set of key performance indicators will be proposed. Monitoring the schedule progress, the project budget and the scope will be possible. Within a Business Intelligence initiative, monitoring is possible by attaching the key performance indicators to the OLAP cube. In turn, the cube was deployed over a proper data warehouse schema.*

1. INTRODUCTION

Current business intelligence (BI) approaches are subordinated to performance management [1], [2], [3], the key performance indicators (KPIs) being an important contributor to the BI value chain [4], [5]. Successful BI initiatives are possible with the support of technologies, tools and systems that are capable to sustain the above mentioned value chain. Along the BI value chain, data is transformed into relevant information and is stored into the data warehouse. The multidimensional cube, deployed above the data warehouse, together with a set of data mining techniques will transform the information into valuable knowledge. The KPIs, technically attached/added to the cube, are further part of the performance management system [4], [6], [7].

The data warehouse environment concept [8], [9] is equivalent to the introduced BI value chain. Despite its dominant technological nuance, performance measuring is not neglected. ***BI projects are deployed based on a suitable data warehouse schema with respect to the imposed key performance indicators***.

Unaninously, project management (PM) is considered „the process of achieving project objectives (schedule, budget and performance) through a set of activities that start and end at certain points in time and produce quantifiable and qualifiable deliverables“ [10]. Methodological approaches to conducting projects have established guidelines for all project live cycle phases: initiation, planning, execution, monitoring&control, and closing [11], 12.], [13]. Experts in project management have estimate that PM is 20% planning and 80% monitoring & control. Monitoring is taken place on schedules, budgets, quality, risks, and scope [14]. Actual state is compared to baseline; ***actual performance is compared with the planned one. Therefore, a minimal set of key performance indicators (KPI) will be introduced to monitor the project's progress during its execution.***

2. MONITORING PROJECT EXECUTION

In general, the purpose of monitoring can be: to assess project results, to improve project management, to promote learning, to understand different stakeholder's perspectives, to ensure accountability [15]. Based on the in Figure 1 introduced project live cycle phases, monitoring is done in parallel with other processes like planning or execution.

Monitoring implies measuring the progress and performance of the project during its execution and communicating the status. Project's performance deviations from the plan are signalized when:

- the team is not working on the correct activities of the project plan;
- the team is not on-schedule with the project objectives;

- the team is not on-budget with the project resources;
- the quality of the work is not acceptable;
- additional project control activities cannot be performed.

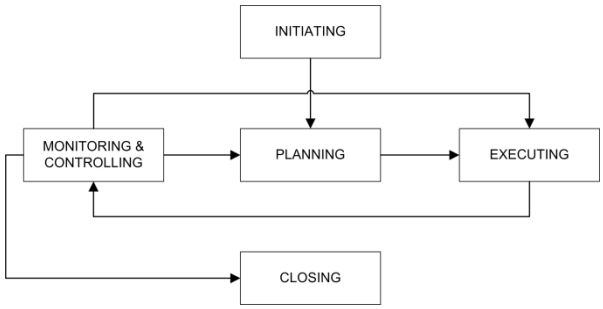

Fig. 1. Project Management Execution phase

Based on the diagnosis, appropriate corrective actions will be taken.

2.1. A MINIMAL SET OF KEY PERFORMANCE INDICATORS PROPOSAL

KPIs are used to assess or measure certain aspects of the business operations (at operational level) and business strategies (at strategic level) that may otherwise be difficult to assign a quantitative value to. Aberdeen Group recent studies have pointed out that "the creation, management and continual review of the KPIs can be difficult because it implies referees to large, complex data volumes and a rapidly changing business dynamics". However, they should be specific, measurable, achievable, result-oriented and time-bound.

Monitoring the progress of a project can be done with the help of a minimal set of KPIs. Three aspects are taken into consideration: schedule progress, budget, and scope.

Monitoring schedule progress can be performed based on the following five KPIs (Table 1). They are referring to the status of the activities that have been scheduled (per week or per month), to the progress of activities (ahead, behind or on-schedule) and to the required course corrections.

Table 1. Schedule progress KPIs

No.	KPI Name	Definition
1.	Activity normal average (ANA)	Represents the daily average value that must be achieved by a specific activity, in order to be successfully completed at the end of a time period.
2.	Activity normal value (ANV)	Represents the normal value for a particular activity acquired in a time interval.
3.	Activity current average (ACA)	Represents the average value of a specific activity in present time.
4.	Activity average progress (AAvP)	Represents the progress recorded by a particular activity (ahead, behind or on-schedule) compared to baseline.
5.	Activity absolute progress (AAbP)	Represents the percentage of a specific activity that has been completed.

Monitoring the budget implies three KPIs (Table 2). They are referring to the amount of budget that has been spent up to o given date, to the amount of remained budget and to the revised estimates to complete a programmed activity.

Table 2. Budget monitoring KPIs

No.	KPI Name	Definition
1.	Activity total cost (ATC)	Represents the amount of budget that has been spent for a specific activity.
2.	Activity total budgeted (ATB)	Represents the amount of budget that has been allocated for a specific activity.
3.	Activity remaining budgeted (ARB)	Represents the amount of budget that has not been spent for a specific activity.

Monitoring the scope is possible with the next three KPIs; being in scope or out of scope will be identified. Also, possible occurred changes that will require a scope addition will be marked.

Table 3. Scope monitoring KPIs

No.	KPI Name	Definition
1.	Project activities on scope (PAS)	Represents the number of project activities that are in scope.
2.	Project activities out of scope (PAoS)	Represents the number of project activities that are out of scope.
3.	Project activities number (PAN)	Represents the total number of project activities.

It is not recommended to track the considered KPIs any more than once per week or any less than once per month.

2.2. DATA WAREHOUSE SCHEMA PROPOSAL

Developing a data warehouse (DW) is quite challenging, several development methodologies have been identified [16], [17], [18], [19], [20], [21], [22], [23], [24], [25].

The design of a representative dimensional model (i.e. data warehouse) can be performed within an agile framework (adapted from [26]) (Figure 2). Four steps are grounding the approach.

STEP1. Conceptual schema design – measures and dimensions will be established (Figure 3).

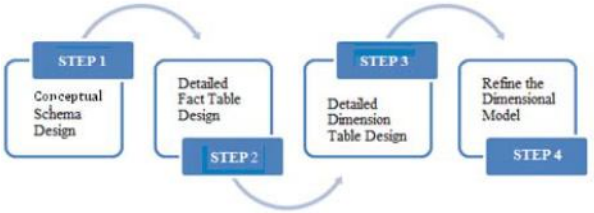

Fig. 2. Data warehouse agile development framework (adapted from [26])

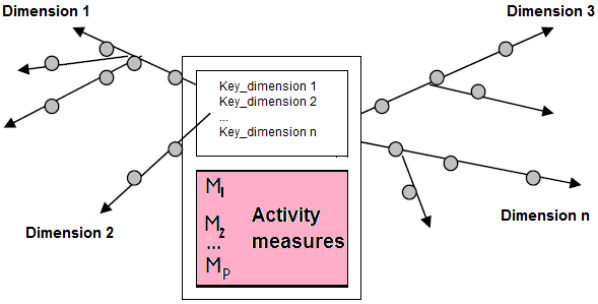

Fig. 3. DW conceptual schema [4]

STEP2. Detailed fact table design

(1) The fact table is linked to all surrounding dimensions.
(2) The primary key of the fact table is defined by the set of foreign keys introduced to join the fact table with all independent dimensions.
(3) The fact table contains the activity measures

$$M_k = f(D_1, D_2, \dots, D_n), \quad k = \overline{1,p}\,. \qquad (1)$$

(4) Dimensional attributes are added to describe dimensional value.

STEP3. Detailed dimension table design - an essential aspect in the detailed dimension table design step, and generally in dimensional modeling is the identification and representation of hierarchies, which define the basis of the aggregation and the analysis processes.

STEP4. Refine the dimensional model - the dimensional modeling activity has to be accompanied by careful assessment of the end-user informational needs and the underlying data supply. Given these arguments, the model will be refined in order to enhance the analysis possibilities and provide a better and simpler model for the decision makers to use.

In this paper, we propose a data warehouse conceptual schema for monitoring project execution. All four steps presented in Figure 2 have been followed in developing the data warehouse. The DW schema has one central fact table (*PROJECT*) surrounded be the six considered dimensions (Figure 4). Five of them contain a hierarchy, enabling different views of the measures.

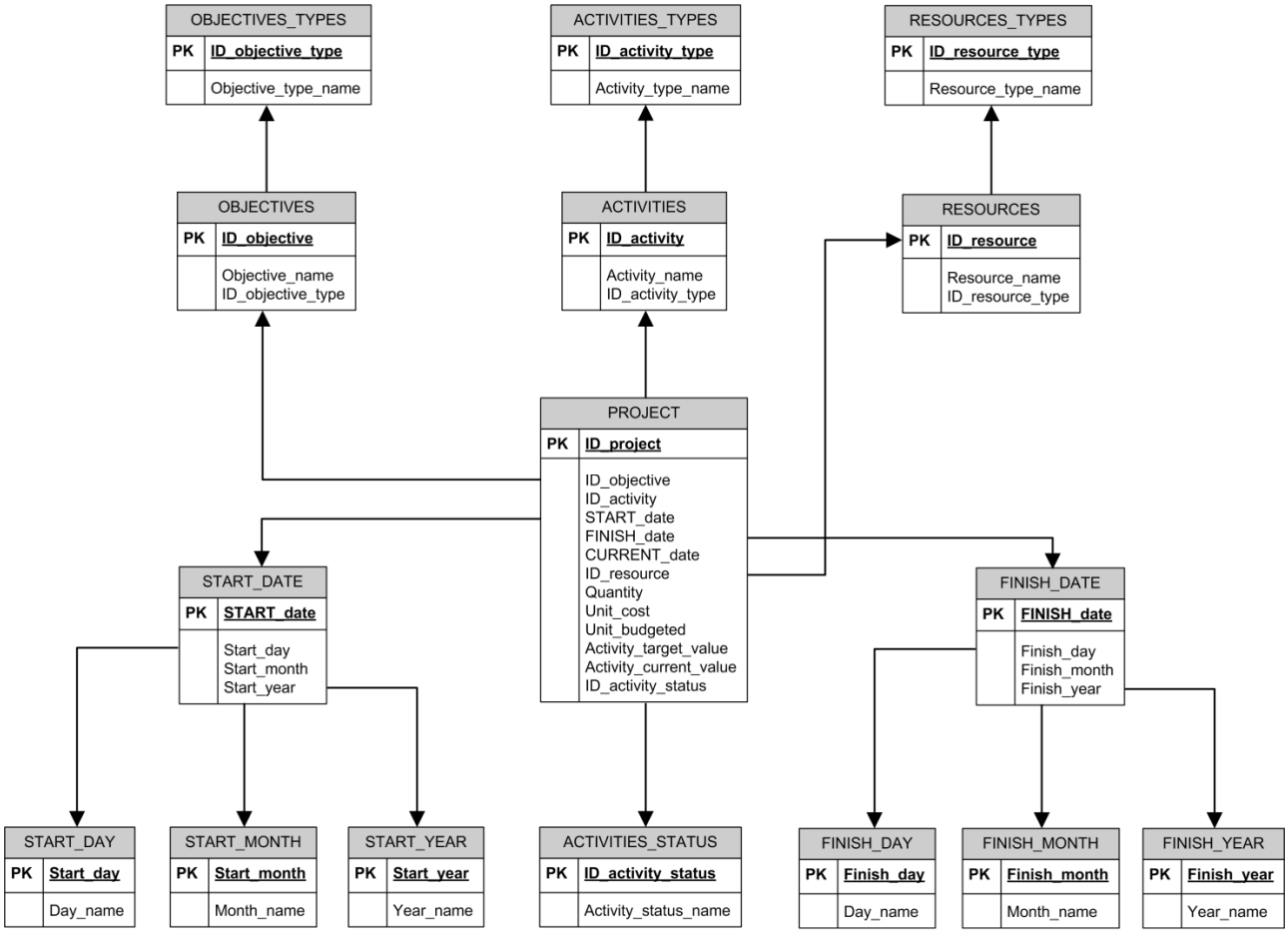

Fig. 4. DW schema proposal for monitoring project execution

Our measures are:

$$M_1 = Quantity;$$
$$M_2 = Unit\_cost;$$
$$M_3 = Unit\_budgeted; \quad (2)$$
$$M_4 = Activity\_target\_value;$$
$$M_5 = Activity\_current\_value.$$

They will be aggregated according to the considered dimensions:

$$D_1 = Objectives \rightarrow Objectives\_Types;$$
$$D_2 = Activities \rightarrow Activities\_Types;$$
$$D_3 = Resources \rightarrow Resources\_Types; \quad (3)$$
$$D_4 = Activities\_Status;$$
$$D_5 = Start\_Day \rightarrow Start\_Month \rightarrow Start\_Year;$$
$$D_6 = Finish\_Day \rightarrow Finish\_Month \rightarrow Finish\_Year.$$

Above the DW, the OLAP cube will be deployed and the considered KPIs can be added to the cube. They will be calculated with the following formulas:

$$ANA = \frac{M_4}{Finish\_date - Start\_date};$$
$$ANV = (Current\_date - Start\_date) * ANA;$$
$$ACA = \frac{M_5}{Current\_date - Start\_date}; \quad (4)$$
$$AAvP = \frac{ACA}{ANA} * 100;$$
$$AAbP = \frac{M_5}{M_4} * 100.$$

For the above five KPIs, recommended for monitoring the schedule progress, a maximal value is desired.

The next group KPIs is used to monitor the budget. According to their definition in Table 2, the following formulas can be used for calculus:

$$ATC = M_1 * M_2;$$
$$ATB = M_1 * M_3; \quad (5)$$
$$ARB = ATB - ATC.$$

While the first KPI is desired to have a minimal value, the other two are appreciated if they have maximal values.

Concerning the third group of KPIs (Table 3), the following ways of determination are proposed.

$$PAS = COUNT\ (ID\_activity)$$
$$WHERE\ Activity\_type\_name = "on\ scope";$$
$$PAoS = COUNT\ (ID\_activity) \quad (6)$$
$$WHERE\ Activity\_type\_name = "out\ of\ scope";$$
$$PAN = PAS + PAoS.$$

While *PAS* is monitored to have a maximal value, *PAoS* is desired to be as minimal as possible.

Although there is a current upsurge in interest for project management software tools, still limited work has been done in this area and little attention has been paid to the use of a data warehouse for monitoring a project execution.

3. CONCLUSION

Based on the fact that 20% is project planning and 80% project monitoring & control within the project management framework, ***our debate was focused on monitoring project execution***. Executing the project plan means carrying out in an effective and efficient way all project activities. In parallel with the Execution phase, performance is measured and analyzed. Advanced analyses capabilities can be implemented into a Business Intelligence initiative. The BI value chain "From DATA To PERFORMANCE" is supported by a data warehouse storage system, above which the OLAP cube will be deployed. The proposed KPIs are offering support for monitoring the schedule, the budged and the scope.

Further researches have in mind additionally KPIs to increase the monitoring capabilities. Also, a concrete implementation will be subject of future work. Present and future initiatives are and will be part of PM general framework.

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