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A Practical 1 Page Contextual Diagram for Monitoring Multiple Projects: An Empirical Study of an IT Organization☆

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ABSTRACT

Company A, an embedded system manufacturer, has been managing multiple development projects. Executives need to understand the risk level of every project and prioritize resource distribution. Traditional project monitoring tools or excel sheets are too complex for calculating the risk factors across a functional organization. Two new charts, "Spear-head Chart" and "Float Chart" were designed to assist high level decision making processes. Two charts were used for weekly executive meetings in order to monitor project progress and rectify project direction. One page graphical monitoring tools in Company A are good enough for high management decision making. Authors explain the characteristics of two charts and propose its practical implementation in real working environment. Spear-head chart was also implemented as a system.

☞ keyword : Process Diagram, Project Monitoring, Project Management, Context Diagram

1. Introduction

Company A, broadly, has two lines of development processes. One is for sequential digital map conversion and compilation processes, such as a chemical process industry characteristic. The other is for embedded discrete software development processes, including memory DB, mobile applications, UI and UX design on several hardware platforms.

Every year, there are above 50 product related projects in Company A. Among these projects, the top ten are prioritized for executive level monitoring. We intend to focus on the best methods of monitoring the risk levels of these top ten projects from the view of a high level executive.

Through our empirical research, we have found that the 'Spear-head Chart' and 'Float Chart' have been used successfully to monitor a project's health and progress, and as therefor provide a strong support for executive decision making. Two charts are positively accepted among middle and high level management.

Company A's middle and high management utilizes Spear-head and Float chart for cross functional and cross disciplinary discussions. While Spear-head and Float Chart do not provide a comprehensive context relating to all of a project's risk factors, two charts are not burdened with an overabundance of unnecessary details and minutiae, and those provide a clear and efficient summary for project evaluation.

The next section will explain some research background rationale for this empirical study, and then present literature review for legacy project monitoring tools. This is followed by Spear-head Chart and Float Chart introduction which are schemed out in Company A.

2. Research Background

2.1 Legacy Project Monitoring Tools

Software development project managers use various project monitoring and management tools including open source based tools. Some companies assign an IT team to review and standardize software tools in their company. The problem is that often these software tools are designed to meet the highly technical needs of a programmer and not the big picture needs of management. As a result these tools are not good for group decision making processes, such as project monitoring or review

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sessions.

Even if PMBOK(Project Management Body of Knowledge) and CobiT(Control Objectives for IT and related Technology) are well referenced for best practice of comprehensive IT project management, they are much too broad for Company A executives to monitor critical checkpoints such as schedule, cost, scope, and quality.

2.2 Need for new Contextual Diagram

Because executives usually need high level contextual report for decision making, Company A executive requirements for alternative monitoring tool were as the below.

- One page visual presentation of multiple project progress (maximum 10 key projects). Spear-head chart is designed for this.
- Easy to know issues, support requirements, contact points for further communication.
- Another one page progress chart for each project for referencing major Work Breakdown Structure (WBS). Float chart is designed for this requirement.
- Easy to check time risk (delayed) according to each milestone, namely GATE.
- Easy to verify the evidence of percent of completion for each project.
- Easy to classify DONE and WAITING tasks in a project.

Company A executives want to affirm project team's confidence by face to face discussion beyond documents or monitoring system. So, they place a great emphasis on utilization of one single visual chart for issue raising and discussion. If executives want to know detailed information during review session, attending engineers may explain, advise and express their opinion with supporting documents.

3. Literature Study

3.1 Critical Success Factors of Project Management

Dealing with individuals or groups (i.e., the project stakeholders) who may affect or be affected by the project processes, contents or outcomes has been acknowledged as a core task within project management for a long time [1]. So, most important part of project management is communication among stakeholder group.

Van de Ven and et al. (1976) classified communication related alternative mechanism into impersonal, personal and group modes [2]. Examples of communication practice in the impersonal mode include project plans, descriptions of jobs and roles for the project, standard project procedures and project newsletters [3]. On the other hand, Turkulainen (2015) explains that personal mode promotes mutual discussion such as face-to-face or through messaging, and group mode bring together a group of people through scheduled and unscheduled meeting and teamwork. Authors believe our recommendation of new communication tool will give better context of understanding across different stakeholders in impersonal, personal and group mode, especially for internal stakeholders.

Davis (2014) mentioned there were no common project success factors for some group and recognized that success was rarely evaluated across multiple stakeholder groups [4]. And he also summarized the dimensions of project success identified in the literature. It was categorized by 3 stakeholder groups such as senior management, project core team, project recipient. Common success dimensions to three stakeholder groups were 'communication' and 'time' only among 9 dimensions [5]. Authors will focus on communication among stakeholders and schedule driven cost check by staged Gate threshold.

Khamooshi and Golafshani (2014) claimed that the concept of schedule monitoring and control as one of the most important functions of project and program management had not been fully exploited. They insisted that one possible explanation could be the dominance of the Earned Value Management System (EVMS) [6]. Hazir (2015) comments that Earned Value Analysis (EVA) is a managerial methodology to monitor and control projects and it use monetary units of cost and schedule variable as a common basis to measure and communicate the progress of a project [7]. As schedule management belongs to an important cost driver in IT project, so project progress monitoring by Gate concept is recommended by authors for cross functional review meeting.

Ingason and Jónassons (2009) classified contemporary knowledge and skill requirements in Project Management with eighteen major categories according to strategy-execution and

leadership-craftsmanship axes. The mapping of the article keywords from 3 sources such as journals, graduate project management program and textbooks shows that many organizations do better in defining their objectives and strategies than in actually executing them in a proficient and effective way [8]. We intend to focus on execution and craftsmanship.

Successful project management comes from various factors including systems, people, organization, attitudes, context, definition and sponsorship. Those seven forces are addressed by Turner and Muller (1999). But, they also found that the leadership style and competence of a project manager has no impact on project success due to the unique, novel and transient nature of individual project [9]. On the other hand, Patanakul (2011) noted that the right project manager assignment on multiple project management is effective for organization learning and customer satisfaction [10]. This paper emphasizes that contextual and visual project monitoring & controlling presentation between project team and stakeholders are important factors for better communication in case of multiple project management environments for effective resource planning, risk management and organization learning also.

3.2 Visual Project Management Tools

Hanisch and Wald (2011) recommended Design, Context and Goal as three dimensional influencing factors in project management. They presented that strategy & structure, project management & project organization belong to design dimension. Complexity, dynamics and uncertainty are under context dimension. Value added and Adaptability are included in goal dimension [11]. Complexity and uncertainty can be resolved by simplified or clear contextual project representation of process planning and proper usage of project management tools.

Process planning and project management tools are diversely utilized, which include Gantt, Pert-CPM. Project management software tools provide good functionality for graphical presentation of causal relationship, time & resource planning and hierarchical structure such as organizational breakdown structure (OBS), and work breakdown structure (WBS). Holzmann (2011) also presented risk breakdown structure (RBS) from lessons-learned documents in an IT organization [12].

But project managers usually evaluate project risk in cost, time, and scope and client satisfaction [13]. Scopes are related to right outputs of project for product or service. And client satisfaction or quality comes from deliverable's conformation to client expectation. Aramvareekul (2006) presented Cost-Time-Risk diagram (CTR) for illustrating current project cost and time performance status associated with evaluated risks in EVA and management [14].

Bernroider and Ivanov (2011) also similarly addressed Iron Triangle (time, cost, and quality) are the key risk components described in CobiT. They articulated "Manage Projects"(PO10) in CobiT framework, and mentioned the 3 level measurement schemes of goals, processes and activities in view of Iron Triangle [15].

Heeler (2011) proposed the degree of completion (DOC) of the tasks with the Schedule Performance Index (SPI) or the Cost Performance Index (CPI) for measuring percentage of completion of a project. SPI or CPI index defines one out of three colors Green, Yellow, Red which explains the healthiness of project progress according to schedule or cost threshold [16]. Authors also adopted color retinal property scheme for risk representation in Spear-head chart and Float charts.

Ishaque et al. (2009) extends the classical duration-based quantitive approaches for project management and monitoring by adding the provision for point (instantaneous) activities and specification of partially ordered relation between system activities. It offers expressive input languages for project managers to input their specification [17]. But, its abstraction level is overly detailed to use in cross disciplinary meeting between functional groups in an organization.

3.3 Visual Project Monitoring Tools

Truc et al. (2012) designed a logical approach to multiple projects management by using a fever chart which plot correlation between project time used and buffer used [18]. This fever chart can provide project managers with an estimated risk level of time constraints in multiple projects.

There are several recommendations for project risk classification matrix. Wickboldt et al. (2011) proposed Risk Classification based on calculated probabilities and impacts into risk classification ranges like 3x3 or 5x5 matrixes. Also risk matrixes are analyzed separately for cost, time, scope and quality [19].

Marcelino-Sádaba et al. (2014) recommended the Risk Priority Index (RPI) multiplied with Impact Metric of Cost, Time, Scope and Risk Probability [20]. They also presented Risk Color Code. Risk Classification Matrix or Risk Color Code is well accepted in real world situations to define the color pattern according to risk level including Spear-head Chart presented in this paper.

George Tsiotras (1993) described two types of meetings during the lifetime of a project. Task team meetings with project teams are held for internal purposes. And task team/supervisor meetings are held between the task team and the group supervisor to discuss open issues that the task team is having difficulty resolving, and to find out if the customer's expectations are met. These meetings will occur upon completion of a key milestone, or during a project crisis, or whenever the supervisor or the project owner finds it necessary [21]. Spear-head and Float Chart address to the contextual communication tools for task team/supervisor meeting.

3.4 Constraints for Legacy Visual Project Monitoring Tools for Multiple Projects

Songer et al. (2004) commented that visual representations of data hold great potential for reducing communication difficulties fostered by industry fragmentation. They compared 5 types of tools such as report table, scatterplot, histogram, tree and tremor for accuracy and intuitive test of quantitative result from Charrette testing. Among them, treemap shows that the percent completion of each pay item is displayed by the degree of shading for each rectangle and budget size is proportional to rectangle area. For cost overrun, shading with the color black begins from the center of the rectangle out [22]. Even though treemap can show the cost hierarchy, overrun and relative cost comparison with color and visual area presentation, it is adapted to construction project and does not show the overall progress of software project according to time domain checkpoints.

One size does not fit all. Laura et al. (2010) discussed the difficulty of controlling a complex project caused by the great number of performance indicators and suggested a method to facilitate project performance analysis via a multi-criteria approach. The method focuses on three particular axes (a graphic presentation of a performance cube) for the analysis of project performance: 1) project task, 2) performance indicator categories, and 3) a breakdown of the performance triptych (Effectiveness, Efficiency, and Relevance) [23]. But, 3 dimensional analytic tools are not easy to understand when utilized in print, even if it provides a better construct of parameter representation. Executive group in Company A requires a contextual project management document or tools by simple 2 dimensional symbolic representation of high level risk management.

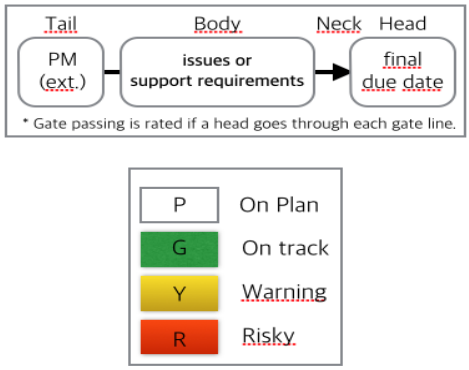
Jianguo Ye (2009) explained Visualization Configuration Model (VCM) with four layer schemes such as Graphical Element, Graph Component, View and Scene [24]. Accordingly, authors utilized the glyph of box shape, color and right-sided orientation for Graphical Elements and do rendering on a 2D coordination system for Graph Components.

4. Alternative Contextual Diagram: Spear-head & Float Chart

4.1 Spear-head Chart

Fig. 1 shows the symbolic representation of Spear-head Chart and meanings of color patterns. Spear-head diagram has four graphical components, namely Head, Body, Tail and Neck of arrow.

The Head represents the final due date for each project. The Body shows project huddle (issues) or support requirement escalation to executive sponsor. The Tail informs who is in charge of project management (project manager) and contact information. Last component is the Neck between Head and Body.

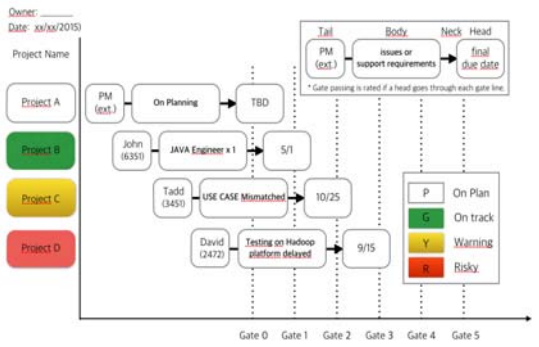


(Figure 1) Spear-head Chart Legend

The position of the Neck is important for checking the Gate stage of the development process. A certain Gate passing is asserted if a Head part goes through each Gate line. The Gate represents project progress milestones. If the Neck of the Spear-head chart does not pass GATE 0, it is regarded being in the planning stage, not launched. So, the chart should have enough left horizontal space in order to position the whole spear body.

By using the Spear-head chart, an executive can compare the progress of key projects that are running simultaneously, check pending issues and understand support requirements requested by project team. Because Gate numbers were marked sequentially rather than by calendar date, management can easily understand and compare the progress of each project. Also, they can align human resources across multiple projects according to strategic importance or project urgency.

The color patterns may apply on the entire Spear-head body (head, body, tail) or only on the project name box as Fig. 2. It isn't so important what notation is used, but it is important that whatever notation is used consistently [25]. Green/Yellow/Red colors can be automatically defined by predefined scales of risk factors. Risk calculation and classification scheme by Wickboldt et al. (2011) can be adopted to make the color scale number [19]. This allows the executive sponsor to focus on troubled yellow or red colored projects.



(Figure 2) Spear-head Chart Example

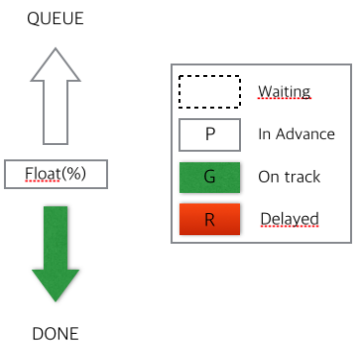
In company A, the quality assurance (QA) team has a risk classification matrix model to define box color. Generally, project due date is pre-determined at the beginning. Body of spear-head which states project issues or support requirement is usually filled out by project managers.

Khalili-Damghani(2014) presented three different types of project solution problems:(1) accept-reject problems, (2) single-project selection problems, (3) multiple-project selection problems where the goal is to select a set of projects from a set of non-mutually exclusive projects[26]. Spear-head Chart is fit for multiple-project selection problem because it shows us multiple projects on the same GATE sequence and gives an insight for the balance of human resource distribution according to GATE stage.

4.2 Float Chart

Compared to Spear-head chart for multiple project evaluation and decision making, Float chart can be utilized for checking each project's percentage of completion. This chart is used complementarily with Spear-head chart. When management wants to understand a project's progress, scope and time constraint, this chart delivers clear visual answers for them.

Fig. 3 shows the symbolic representation of Float Chart and the meanings of color patterns. Float chart is utilized for individual project planning, actual progress monitoring and control. In this chart, Float plays the important role of being a separator between to-do tasks and finished tasks. Waiting and unfinished tasks are positioned over Float marks. When tasks are well performed, these finished tasks move down under Float mark. So, float is initially located at the bottom. Float will be located at the top of every task silo for each GATE if all tasks finished. Evaluator can easily distinguish the progress of tasks.

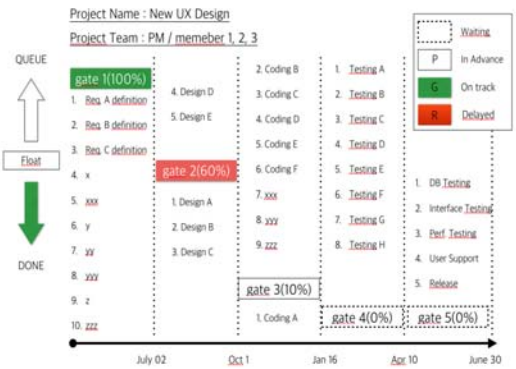


(Figure 3) Float Chart Legend

Every project stage between Gates has a Gate float as Fig. 4. At the beginning stage, the float positions on the bottom

and to-be tasks are located on the top of float. Float outer lines are dotted type on waiting stage. Dotted Lines will be changed into solid lines after performing. Color pattern shows White for advanced, Green for on-track, Red for delayed stage. Float percentage means percentage of task completion in each Gate stage. If all tasks in a stage are finished, then float percentage will get 100% percentile.

Objective calculation of floating percentage may be done by work breakdown structure (WBS) man-day achievement. Project managers can add issues or support requirements description below the timeline axis of float charts. By using one page float chart, executive sponsor may easily understand the progress of each project.



(Figure 4) Float Chart Example

Even though all tasks may be finished in each GATE stage, the Float color should be maintained as red if PM could not meet the staged GATE due date. The power of this chart comes from comparative weekly or monthly review with previous Float charts. Evaluator can easily distinguish the GAP between plan and actual.

4.3 Benefits of Charts

In an environment of globalization, intense competition and rising R&D costs, collaboration has become an essential means of sustaining technological growth (Barnes, 2006). However, there are many difficulties inherent in managing projects across organizational boundaries [27]. Authors evaluate those difficulties mainly came from communication across multiple organizations. So, simple and 1 page visual communication tool will be useful for cross functional project review and decision making.

The above two types of charts were enough for high level executive project review session. Company A implemented Fig. 2 like contextual monitoring display on project management system (PMS). But, Fig 4 chart was not implemented as a system. Each PM prepared one page Fig. 4 PPT chart at project planning stage and utilized it through whole project period by modifying detailed progress.

Spear-head fulfills the following requirements.

- One page presentation for 10 projects.
- Easy to check time risk (delayed).
- Easy to know temporal gap between plan and actual.
- Easy to know issue, support requirement.
- Fast communication with project manager.

Float chart also satisfies the following requirements.

- One page progress chart for each project.
- Easy to verify the evidence of percent of completion.
- Easy to classify major WBS DONE and WBS WAITING tasks.
- Further study itemization of lessons learned for project schedule GAP between plan and actual achievement according to each Gate stage.
- Effective communication of key support requirements with project stakeholders.

4.4 Limitations of Charts

The Spear-head Chart does not represent all risk factors which are intrinsic in each project. It mainly explains the comparative schedule progress, and issues or support requirements among multiple projects. In order to compare each project, the definition of each Gate should be clearly stated.

Float chart complementarily illustrates the percentage of completion with abstracted WBS of a project. Time, Cost, Scope attributes are much more focused on rather than Quality. Abstraction layer of WBS in Float chart is higher than traditional WBS list because its basic scheme is one page chart. So, detailed WBS may not be described in one page chart. Drill down or pop-up function will resolve this issue.

5. Conclusion and Future Study

Parry & Turner (2006) proclaimed that visual tools formed an important part of the communication process which drives lean factories. And they believed that any manager who could not draw their process on a single A4 piece of paper is unlikely to be able to manage it [28]. Authors agree with their opinion. We consider that 1 page visual tool is full enough for cross functional executive communication at the initial stage.

According to Marnewick and Labuschagne (2011) in South Africa, the majority of the organization do have corporate governance in place but they do not comply with IT and IT project governance [29]. Even though their survey comes from a South Africa context, IT project governance needs easier use of tools across multi-disciplinary organization including sales, marketing, and R&D, finance and quality team.

The main contribution of this empirical research is the proposed contextual diagram of project monitoring and decision making for executive project sponsors. Spear-head Chart is useful for high managers to easily evaluate and compare the progress of multiple projects. Float Chart is also helpful to check the achievement milestone of abstracted WBS (work breakdown structure) in each project.

The contextual level of these two charts is relatively higher than other monitoring tools, because they are 1 page practical visual monitoring tools for executive level. Main objective of using these charts is to increase immediacy for high management, especially cross functional leaders to make a faster decision making.

Future investigations could extend multiple case studies to apply the above two contextual diagrams for other real project monitoring and control. And executive level survey would be another investigation area because traditional legacy project monitoring tools sometimes lack an ease to use and understanding for high level executive sponsor. “One size fits for all” approach does not always apply for every member of project stakeholders.

System implementation for Float Chart will be another area. The limitation of WBS layered presentation will be resolved if click and unfolding functions is implemented for displaying level 2 WBS.

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