The best alternative for solving uncertainties in complex IT project planning, risk management, and change management[1, 2]

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ABSTRACT

In spite of the continuous growth of investments and investigations for project management, yet there have been none apparent improvements of the total success rate of projects since the 21st century, which is a paradox in the project management fields.

This article aims to manage complex IT projects by using new theories and methods. One of the essential features of a failure complex IT project is the high degree of uncertainty, which is the subject of this crucial point. Individually, the high uncertainty leads to high risks result that need to be handled by particular methods and processes of risk management.

The purpose of investigating complex IT projects is not only to summarize the best practices/methods of this approach but also to improve management activities and the practice of various projects to address low success rates. Therefore, this paper help to solve some of the problems in the field of IT project management, and finally gives some valuable advice on general IT projects.

Keywords: complex IT projects, Agile, project planning, project risk management, project change management, Line of Balance, Critical Chain, ITIL.

INTRODUCTION

In 2016, Standish Group, tracked the implementation of IT projects in the United States from 2011 to 2015 and published a series of reports entitled Chaos. According to the series of reports, "about 50% of IT projects exceeded the budget between 2011 and 2015, although this figure has improved a lot since 2000, but it is still high"[3]. The main reason for this improvement is the improvement of project management.

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[2] How to cite this paper: Sun, H. (2019). The best alternative for solving uncertainties in complex IT project planning, risk management, and change management, *PM World Journal*, Vol. VIII, Issue VII, August.

[3] Standish Group (2016) CHAOS Report. Retrieved November 2018, from https://www.standishgroup.com/store/services/10-chaos-report-decision-latency-theory-2018-package.html

Chaos report follows:

	2011	2012	2013	2014	2015
SUCCESSFUL	29%	27%	31%	28%	29%
CHALLENGED	49%	56%	50%	55%	52%
FAILED	22%	17%	19%	17%	19%

Figure 1. Chaos Report Data[4]

Remark:

Project Success (Green): The project is completed on time and on budget.

Project Challenged (Yellow): The project is completed over-time or over-budget.

Project Impaired (Red): The project is canceled at some point during the development cycle.

According to the survey report, it is clear that there are many problems in IT project control. We can understand project control through the guild:

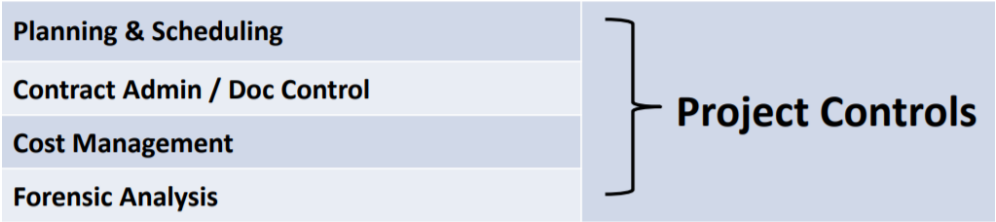

Figure 2. Standards of Practice (SoP) [5]

These problems can be summarized as:

"Business involvement is inconsistent or results in confusion,

Fuzzy business objectives,

Requirements definition processes do not reflect business need,

Lack of complete agreement when projects are done."[6]But behind these appearances, in my view, the deeper reason is that the complexity of IT projects is increasing, the IT project managers lack the awareness of complexity, and the high uncertainty and high risk of IT projects lead to this chaotic situation.

So, what is complex project management? Recognizing the complexity of the project, first of all, is to recognize the complexity of the project, and then put forward the concept of complex

[4] Standish Group (2016) CHAOS Report. Retrieved November 2018, from https://www.standishgroup.com/store/services/10-chaos-report-decision-latency-theory-2018-package.html
[5] Definition of SoP by Guild of Project Controls Retrieved November 2018, from http://www.planningplanet.com/guild/gpc
[6] Aleksandar, R. (2017) Why do so many it projects fail? Retrieved November 2018, from https://www.oshyn.com/blogs/2017/january/why-do-so-many-it-projects-fail

projects, which have complex project management. However, recent results from some project management studies have shown that "project complexity is common to almost all projects, but not all projects can be classified as complex projects. Complex projects have the following characteristics: Uncertainty, ambiguity, dynamic interfaces, and significant political or external influences; Usually run over a period which exceeds the technology cycle time of the technologies involved; Can be defined by effect, but not by a solution."[7] The original intention of the complex project as a concept is to solve the problem that the compliance rate of the project targets in the global scope is still low after entering the 21st century. For this reason, some experts have proposed to introduce new theories to support project management.

The following table is a standard for project management complexity rating from GAPPS:

Project Management Complexity Factor	Descriptor and Points			
1. Stability of the overall project context	Very high (1)	High (2)	Moderate (3)	Low or very low (4)
2. Number of distinct disciplines, methods, or approaches involved in performing the project	Low or very low (1)	Moderate (2)	High (3)	Very high (4)
3. Magnitude of legal, social, or environmental implications from performing the project	Low or very low (1)	Moderate (2)	High (3)	Very high (4)
4. Overall expected financial impact (positive or negative) on the project's stakeholders	Low or very low (1)	Moderate (2)	High (3)	Very high (4)
5. Strategic importance of the project to the organisation or organisations involved	Very low (1)	Low (2)	Moderate (3)	High or very high (4)
6. Stakeholder cohesion regarding the characteristics of the product of the project	High or very high (1)	Moderate (2)	Low (3)	Very low (4)
7. Number and variety of interfaces between the project and other organisational entities	Very low (1)	Low (2)	Moderate (3)	High or very high (4)

Figure 3. Crawford-Ishikura Factor Table for Evaluating Roles[8]

"Complex IT projects, as a subset of complex projects, have the general characteristics of complex projects: the clarity of project objectives, the integrity of management objects, the interdependence between projects and the environment, and the uniqueness of project outcomes."[9] "But the development of complex IT projects different from other building products manufacturing or engineering, the entire process is mainly intellectual creation, does not require the use of large amounts of material resources, and its main resource is human resources and

[7] Naomi, C. (2016) How to Manage a Complex Project? Retrieved November 2018, from https://www.projectmanager.com/blog/manage-a-complex-project
[8] GAPPS Complexity Rating Tools | GAPPS. Retrieved November 2018, from https://globalpmstandards.org/tools/complexity-rating/
[9] BCS (2006) Case Study of Successful Complex IT Projects. Retrieved November 2018, from https://www.bcs.org/upload/pdf/casestudy2.pdf

information resources."[10] The project deliverables are often code, technical documentation, information service, it is a logical entity, not a specific physical entity.

1. Case

Industrial and Commercial Bank of China is the first national commercial bank in China to complete the construction of "data concentration". The business data of the whole bank is centrally calculated and processed by the production data center. The information technology department will initiate the data center host database upgrade project to ensure the integrity and security of the business data. Under the premise, complete the upgrade of the production, test, and development center host database while maintaining full compatibility with the original application software.

2. Problem definition

2.1 Because there are many uncertain factors, such as the project's final production time in the production data center, the final database version update, the amount of application software updates required, the workload of the test, etc. Those can be not determined at the beginning of the project.

2.2 Although the project is the subject of migration and data center consolidation, but actually contains the contents of the planning and reconstruction of the data center consolidation, and these jobs have high demands on risk identification and control.

2.3 Change is a process that often appears IT project, but also a daunting challenge facing IT project management because the changes are "unplanned" and introduce some uncertainty and project risks.

METHODOLOGY

STEP 1: PROBLEM/OBJECTIVE STATEMENT

1. For complex IT projects, how to plan to deal with this uncertainty?

2. How do you classify risks for complex IT projects? How to identify risks? How to avoid risks?

3. How to apply ITIL change management to actual cases?

STEP 2: FEASIBLE ALTERNATIVES

According to the case described above,

[10] Schulte, P. (2004). Complex IT project management: 16 steps to success. Boca Raton, FL: Auerbach Publications

We aim to complete the upgrade of the production, test, and development center host database while maintaining full compatibility with the original application software.

First, we need to choose a model of software development.

Common software development methods: Waterfall development, Iterative development, and Agile development.

1. Waterfall development: "Waterfall is a linear approach to software development. In a true Waterfall development project, each of these represents a distinct stage of software development, and each stage generally finishes before the next one can begin. There is also typically a stage gate between each; for example, requirements must be reviewed and approved by the customer before design can begin."[11]

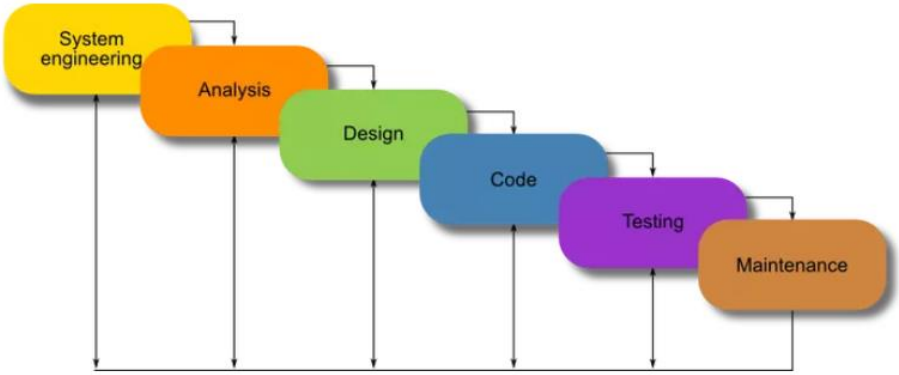

Figure 4. Waterfall model[12]

2. Iterative development: "Iterative development is a way of breaking down the software development of a large application into smaller chunks. In iterative development, feature code is designed, developed and tested in repeated cycles. With each iteration, additional features can be designed, developed and tested until there is a fully functional software application ready to be deployed to customers."[13]

[11] Mary, L. (July, 2013) Waterfall vs. Agile: Which is the Right Development Methodology for Your Project? Retrieved November 2018, from https://www.seguetech.com/waterfall-vs-agile-methodology/
[12] Andrew, P. M. (December, 2016) Waterfall Model: What Is It and When Should You Use It? Retrieved December 2018, from https://airbrake.io/blog/sdlc/waterfall-model
[13] Margaret, R. (November, 2011) iterative development. Retrieved November 2018, from https://searchsoftwarequality.techtarget.com/definition/iterative-development

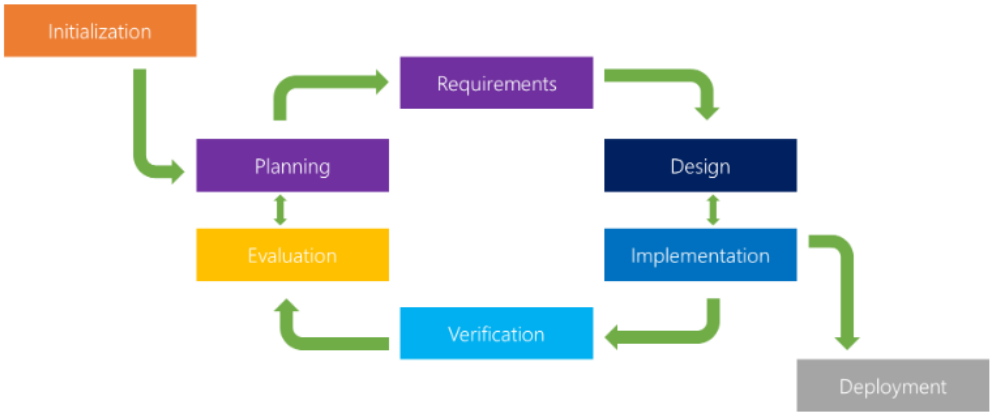

Figure 5. Iterative model[14]

3. Agile development: "Agile is an iterative, team-based approach to development. This approach emphasizes the rapid delivery of an application incomplete functional components. Rather than creating tasks and schedules, all time is "time-boxed" into phases called "sprints." Each sprint has a defined duration (usually in weeks) with a running list of deliverables, planned at the start of the sprint. Deliverables are prioritized by business value as determined by the customer. If all planned work for the sprint cannot be completed, work is reprioritized and the information is used for future sprint planning."[15]

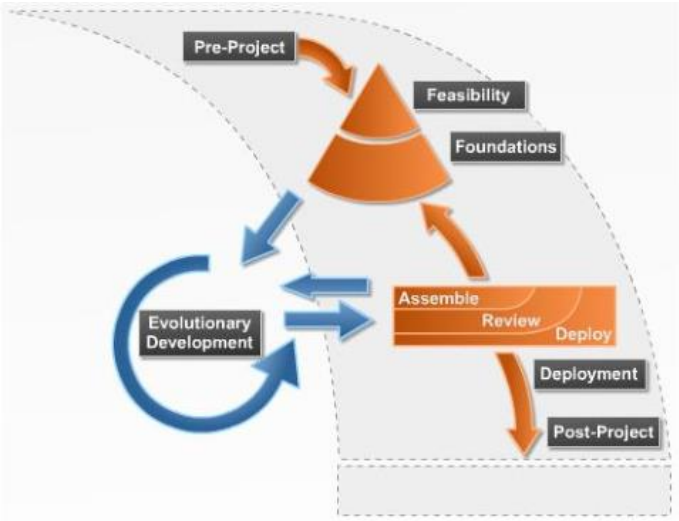

Figure 6. The basic model for Agile[16]

[14] Andrew, P. M. (December 2016) Iterative Model: What Is It And When Should You Use It? Retrieved December 2018, from https://airbrake.io/blog/sdlc/iterative-model
[15] Denisse, M. (February 2018) Traditional vs. Agile Software Development Method: Which One is Right for Your Project? Retrieved November 2018, from https://dzone.com/articles/traditional-vs-agile-software-development-method-w
[16] Agile Foundation Interactive Training Course User Guide | Training Bytesize Retrieved December 2018, from http://lms.trainingbytesize.com/PdfOpener.aspx?DocumentID=1681&filename=/Downloads/1681/AgilePM%20Foundation%20User%20Guide%20.pdf&r=481553dd-d73c-4e95-b255-910bb783ef5b

In this case, we choose the agile model.

Reason: As a linearly developed waterfall model, it is not suitable for complex IT projects. "Agile is iterative already but it is way more than just iterative."[17] The cycle of agile development may be shorter and more emphasis on the high level of collaboration within the team.

Second, we choose the feasible methods in Plan, Risk Control and Change.

Plan:

1. Rolling Wave Planning: "Rolling wave planning (RWP) is a project management technique that involves more detailed planning for short-term than long-term work items. As each item gets closer, it is planned in greater and greater detail."[18]

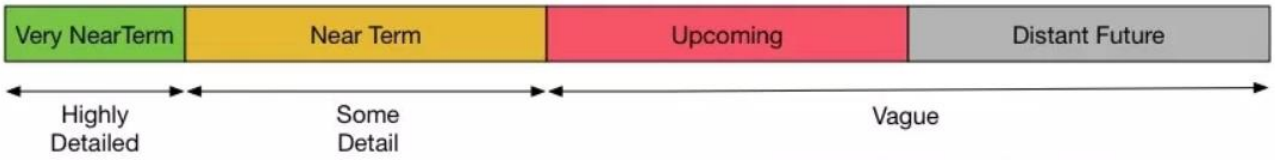

Figure 7. Rolling wave planning overview[19]

2. CPM: "Critical path method (CPM) is a resource-utilization algorithm for scheduling a set of project activities. The essential technique for using CPM is to construct a model of the project that includes the following: A list of all tasks required to complete the project; The dependencies between the tasks; The estimate of time (duration) that each activity will take to complete."[20]

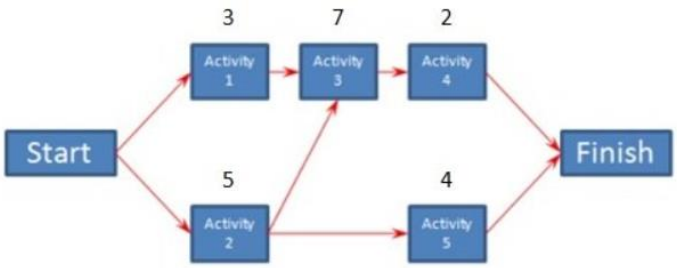

Figure 8. An example of CPM[21]

[17] Sandy, M. (March 2012) Should we choose Iterative or Agile? Retrieved November 2018, from https://nomad8.com/should-we-choose-agile-or-iterative/
[18] Bernie, R. (June 13, 2014) Rolling Wave Planning in 4 Easy Steps. Retrieved November 2018, from http://www.projectengineer.net/rolling-wave-planning-in-4-easy-steps/
[19] The Disciplined Agile (DA) Framework | A Foundation for Business Agility. Retrieved December 2018, from http://www.disciplinedagiledelivery.com/rolling-wave-planning-intro/
[20] Andrew, S. (October 25, 2018) Critical Path Method: A Project Management Essential. Retrieved November 2018, from https://www.wrike.com/blog/critical-path-is-easy-as-123/
[21] The Critical Path Method (CPM) | Project management skills. Retrieved December 2018, from https://www.project-management-skills.com/

3. Line of Balance: "Line of Balance (LOB) is a method of showing the repetitive work that may exist in a project as a single line on a graph. A LOB Chart shows the rate at which the work that makes up all of the activities has to be undertaken to stay on schedule."[22]

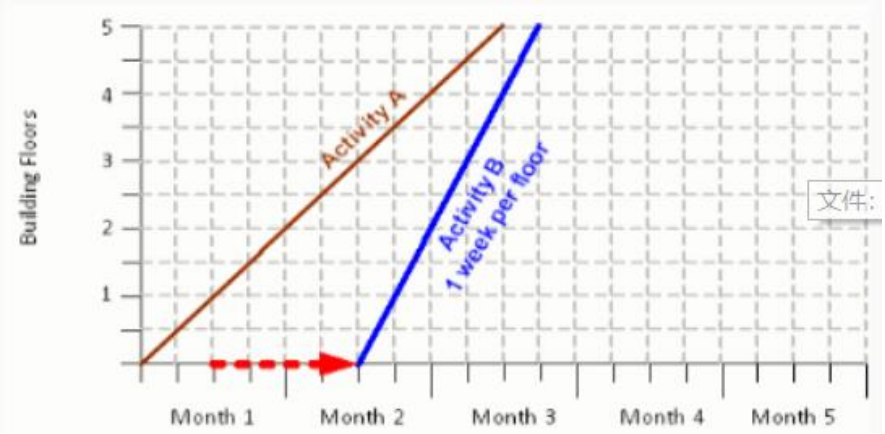

Figure 9. A case of LOB[23]

Risk Control:

1. Decision Tree: "A decision tree is a graphical representation of possible solutions to a decision based on certain conditions. It's called a decision tree because it starts with a single box (or root), which then branches off into a number of solutions, just like a tree."[24]

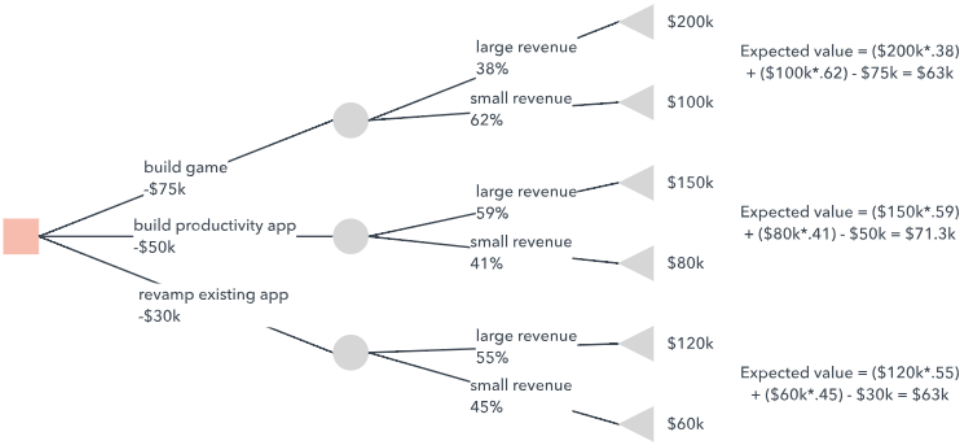

Figure 10. A decision tree with calculating values[25]

[22] Line of Balance | Mosaic. Retrieved December 2018, from https://mosaicprojects.com.au/WhitePapers/WP1021_LOB.pdf
[23] Line of balance (LOB) | Designing Buildings Wiki. Retrieved December 2018, from https://www.designingbuildings.co.uk/wiki/Line_of_balance_(LOB)
[24] Douglas, H (2018) What Is a Decision Tree? Examples, Advantages & Role in Management. Retrieved November 2018, from https://study.com/academy/lesson/what-is-a-decision-tree-examples-advantages-role-in-management.html
[25] By Author

2. Critical Chain: "Critical Chain takes a different approach to handle risk versus. By utilizing a pooled or aggregated risk methodology, task durations can be shortened to the task's average time to completion, and the variability of the tasks in actuality can be planned for and handled via buffers placed in locations that protect the project as a whole."[26]

   Theory Of Constraints: "TOC is a management paradigm that views any manageable system as being limited in achieving more of its goals by a very small number of constraints."[27] This means that processes, organizations, etc., are vulnerable because the weakest person or part can always damage or break them or at least adversely affect the outcome.

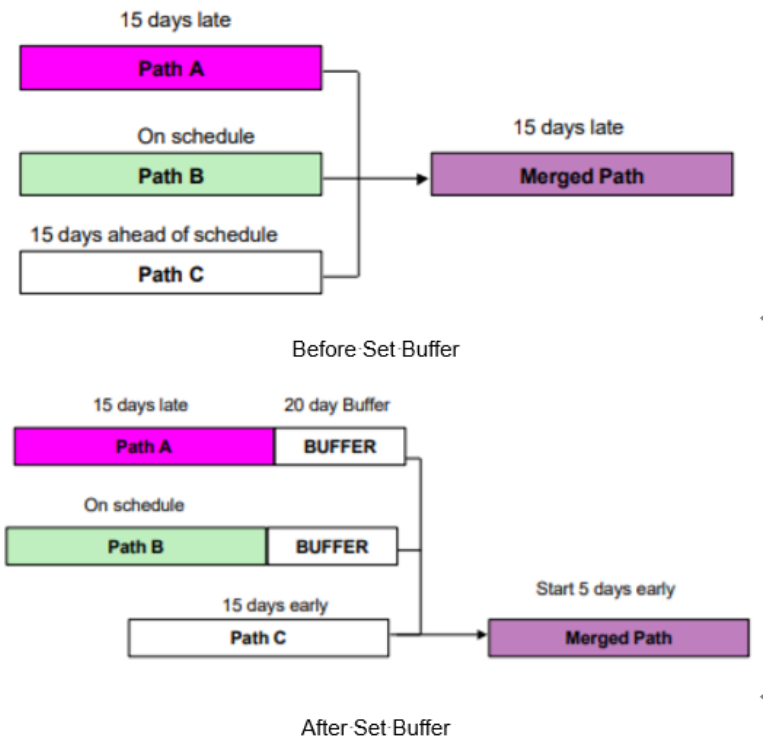

Figure11. A typical example of using a buffer[28]

"Work expands so as to fill the time available for its completion." (Cyril Northcote Parkinson, naval historian and management theorist.)

[26] Hilbert, R. (March 2010) Critical Chain Project Management: Motivation & overview. Retrieved November 2018, from https://ieeexplore.ieee.org/document/5446879
[27] Eliyahu, M. G. (1998) *Essays on the Theory of Constraints.* Great Barrington, MA: North River Press.
[28] Larry, P. L. (2000) Critical Chain Project Management Improves Project Performance. Retrieved November 2018, from http://www.cin.ufpe.br/~gmp/docs/papers/The%20critical%20chain.pdf

There are two other laws formulated by the Cyril Northcote Parkinson, derived from his observations: "Expenditures rise to meet income; The time spent on any item of the agenda will be in inverse proportion to the sum [of money] involved".

How to set a suitable buffer? Different buffer sizes correspond to a different probability of on-time delivery.

Here are two approaches to establishing buffers or contingency:

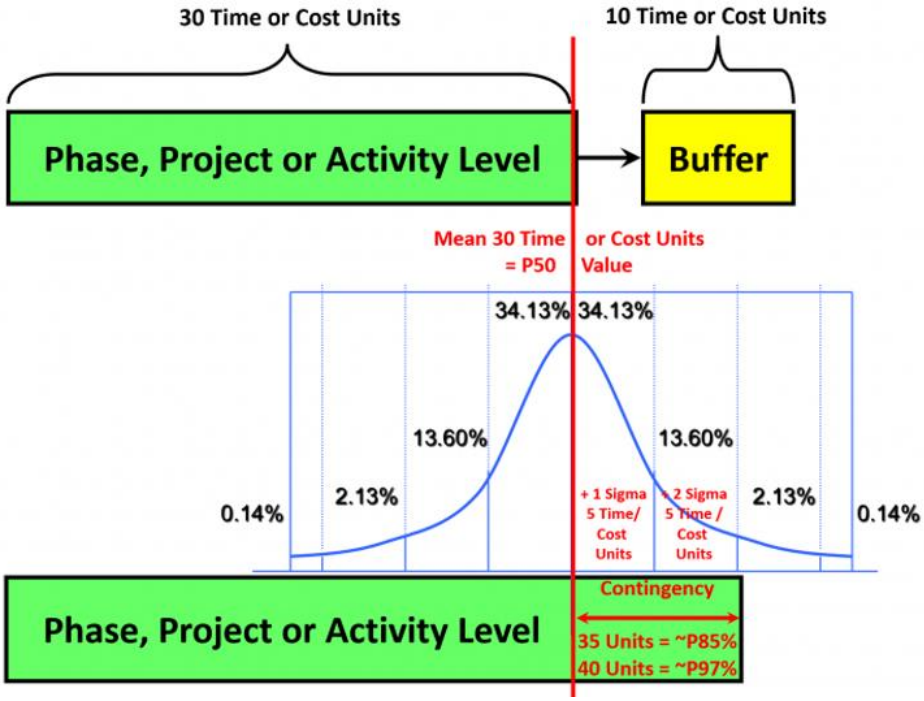

Figure 12. The different between buffers and contingency[29]

Change:

1. ITIL Change Management: "The Change Management process is designed to help control the life cycle of strategic, tactical, and operational changes to IT services through standardized procedures. The goal of Change Management is to control risk and minimize disruption to associated IT services and business operations."[30]

[29] Explains there are Two Approaches to Establishing Buffers or Contingency by Guild of Project Controls Compendium and Reference (CaR) Retrieved December 2018, from http://www.planningplanet.com/guild/gpccar/risk-opportunity-monitoring-and-control
[30] Anthony, O. (2011) The Essential Guide to ITIL Change Management. Retrieved November 2018, from https://www.cherwell.com/library/essential-guides/essential-guide-to-itil-change-management/

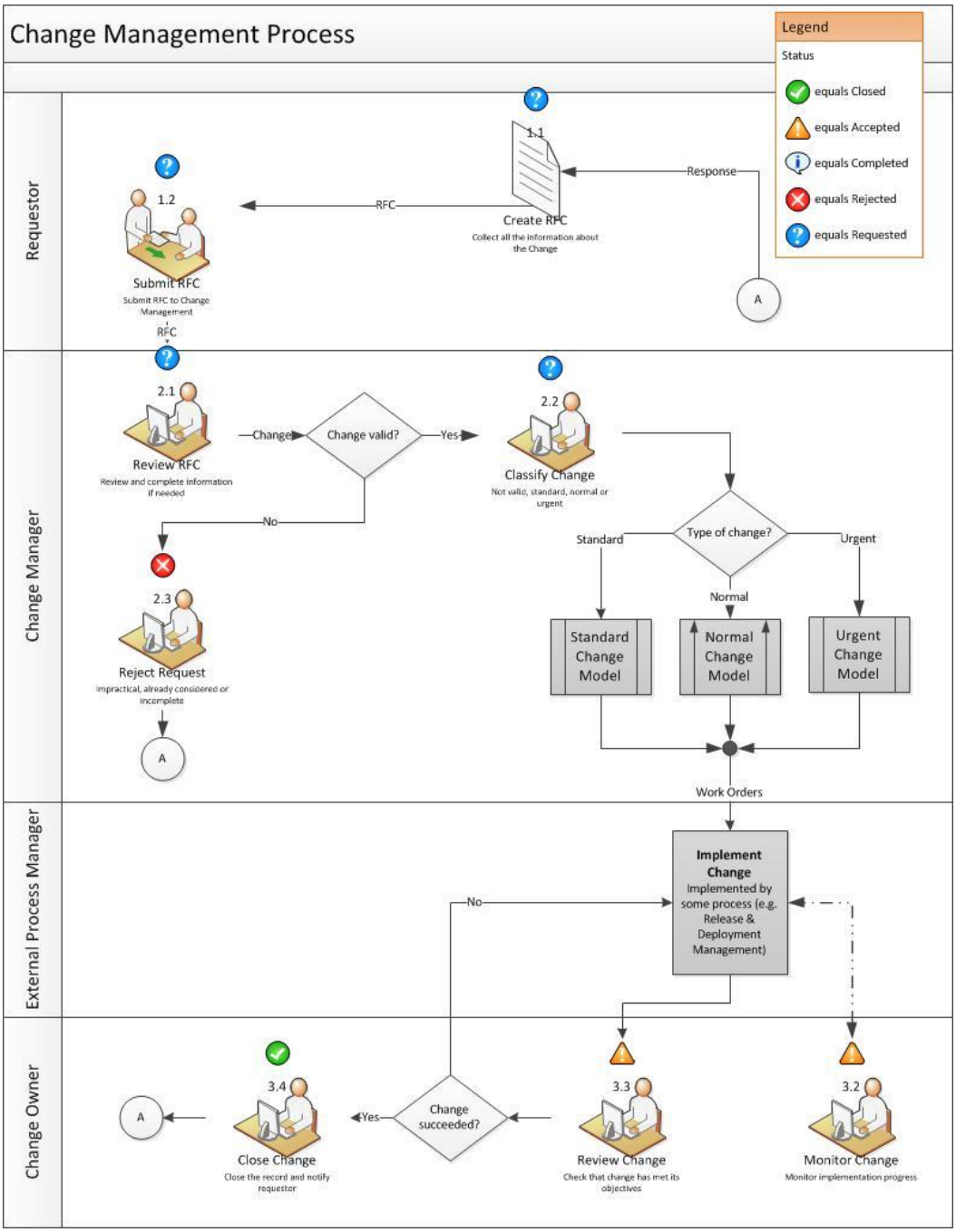

Figure 13. ITIL Change Management Process[31]

2. XPM: "Extreme project management (XPM) is the opposite of Waterfall in that it offers you a way to manage massive change and still move forward to project completion. In XPM, you can alter the project plan, budget, and even the final deliverable to fit changing needs, no

[31] Madison, H (May 2017) ITIL Change Management Process: Models You Need to Know. Retrieved November 2018, from https://blog.masterofproject.com/change-management-process-itil/

matter where the project is. It's the perfect way to manage projects that have a short timeline of anywhere from a few weeks to mere days."[32]

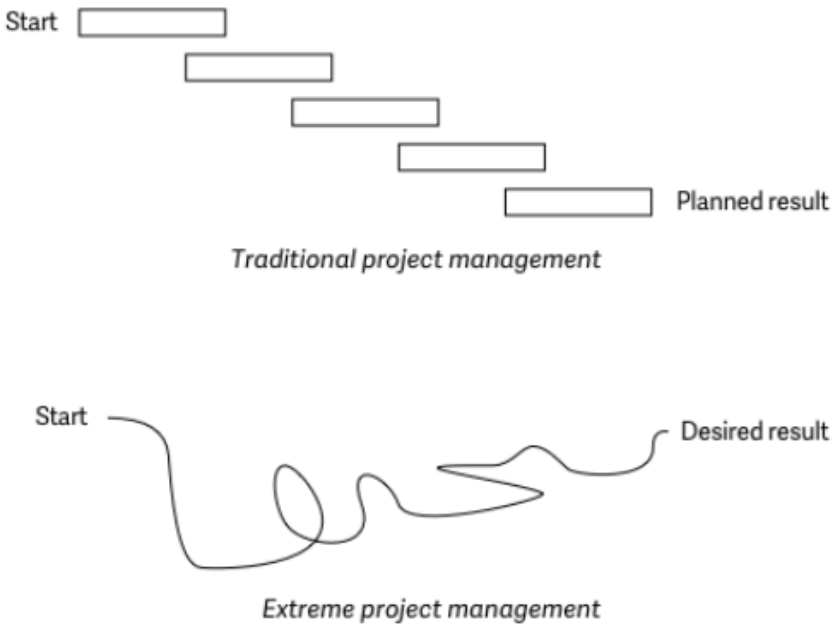

Figure14. A comparison between traditional project management and XPM[33]

Finally, we describe each attribute through smart goals.

"smart goals:

1. Specific: Well defined, clear to anyone that has a basic knowledge of the project.
2. Measurable: Know if the goal is obtainable and how far away completion is find out when you have achieved your goal.
3. Agreed Upon: Agreement with all the stakeholders what the goals should be.
4. Realistic: Within the availability of resources, knowledge and time.
5. Time-Based: Enough time to achieve the goal, not too much time, which can affect project performance."[34].

[32] The Ultimate Introduction to Project Management Fundamentals | Wrike. Retrieved December 2018, from https://www.wrike.com/project-management-guide/methodologies/
[33] Maja, M. (July 2017) Extreme Project Management XPM. Retrieved December 2018, from https://activecollab.com/blog/project-management/extreme-project-management-xpm
[34] Duncan, H. (May 2014) SMART GOALS. Retrieved December 2018, from https://www.projectsmart.co.uk/smart-goals.php

Step	Attributes Concept	Related Description In The Project
1	Specific What is it you want to achieve in your business?	After upgrading the database, the integrity and security of the banking data cannot be destroyed.
2	Measurable You must be able to track progress and measure the result of your goal.	Database and application software performance metrics, availability metrics, business continuity metrics, and **budget** are all within acceptable limits.
3	Agreed Upon Your goal must be relevant to your stakeholders and agreed with them.	The new and old versions are compatible with tools from existing third-party vendors. Protect the company's upfront investment.
4	Realistic Your goal should be stretching, but realistic and relevant to you and your company.	Database software upgrades are implemented within the specified time window, and the impact on business availability is within the scope of the plan.
5	Time-Based Goals must have a deadline. It's a good idea to set some short-term milestones along the way to help you measure progress.	The entire project is divided into several stages of technical preparation (2 weeks), development (3 weeks), testing (5 weeks), verification (1 week) and commissioning (3 days). 80 days in total.

Figure 15. Attribute list[35]

STEP 3: DEVELOPMENTS OF OUTCOMES

Based on the characteristics of each method, we use attributes to evaluate their level in this project.

Attributes	Plan			Risk Control		Change	
	RWP	CPM	LOB	Decision Tree	Critical Chain	ITIL	XPM
Specific	FAIR	EXCELLENT	GOOD	FAIR	GOOD	EXCELLENT	GOOD
Measurable	GOOD	FAIR	EXCELLENT	EXCELLENT	FAIR	GOOD	POOR
Agreed Upon	GOOD	POOR	FAIR	FAIR	EXCELLENT	GOOD	EXCELLENT
Realistic	FAIR	FAIR	GOOD	EXCELLENT	FAIR	GOOD	GOOD
Time-Based	POOR	GOOD	EXCELLENT	GOOD	FAIR	FAIR	FAIR

Figure 16. Multi-Attribute Decision making[36]

[35] By Author. Data Sources: ICBC. Retrieved December 2018, from http://www.icbc.com.cn/icbc/en/announcement/default-PageList-2.htm
[36] By Author

To distinguish the importance of these standards, we rate them to find which standards are the primary criteria for alternatives.

Attributes	Specific	Measurable	Agreed Upon	Realistic	Time-Based	Ordinal Ranking
Specific	X	1	1	1	1	5
Measurable	0	X	0	1	0	2
Agreed Upon	0	1	X	1	1	4
Realistic	0	0	0	X	0	1
Time-Based	0	1	0	1	X	3

Figure 17. Scoring Matrix[37]

Based on the above figures, we can understand the performance of each alternative solution based on each standard.

After analysis, we can create a relative ranking for each alternative based on the attributes. Based on the selected attributes, we decided to choose the best alternative.

Ordinal Ranking		Relative ranking of each alternative based on attribute	
5	Specific	Plan	CPM>LOB>RWP
		Risk Control	Critical Chain>Decision Tree
		Change	ITIL>XPM
4	Agreed Upon	Plan	RWP>LOB>CPM
		Risk Control	Critical Chain>Decision Tree
		Change	XPM>ITIL
3	Time-Based	Plan	LOB>CPM>RWP
		Risk Control	Decision Tree>Critical Chain
		Change	ITIL=XPM
2	Measurable	Plan	LOB>RWP>CPM
		Risk Control	Decision Tree>Critical Chain
		Change	ITIL>XPM
1	Realistic	Plan	LOB>RWP=CPM
		Risk Control	Decision Tree>Critical Chain
		Change	ITIL=XPM

Figure 18. Rank order candidates based on attributes[38]

[37] By Author
[38] By Author

STEP 4: SELECTION CRITERIA

After quantifying relative rankings, the criteria can be defined as follows:

Value	Formula	Dimensionless Value
Excellent	Relative Rank (4-1)/(4-1)	1
Good	Relative Rank (3-1)/(4-1)	0.67
Fair	Relative Rank (2-1)/(4-1)	0.33
Poor	Relative Rank (1-1)/(4-1)	0

Figure 19. Criteria table[39]

Apply this criterion to Figure15. By calculation, the following table is obtained:

Attributes	Plan			Risk Control		Change	
	RWP	CPM	LOB	Decision Tree	Critical Chain	ITIL	XPM
Specific	0.33	1	0.67	0.33	0.67	1	0.67
Measurable	0.67	0.33	1	1	0.33	0.67	0
Agreed Upon	0.67	0	0.33	0.33	1	0.67	1
Realistic	0.33	0.33	0.67	1	0.33	0.67	0.67
Time-Based	0	0.67	1	0.67	0.33	0.33	0.33
Total	2	2.33	3.67	3.33	2.66	3.34	2.67

Figure 20. Non-dimensional scaling results[40]

FINDINGS

STEP 5: ANALYSIS & COMPARISON OF THE ALTERNATIVES

In this step, we will compare all the alternatives and give the ordering.

[39] By Author
[40] By Author

	Step1	Step2	RWP		CPM		LOB		Decision Tree		Critical Chain		ITIL		XPM	
	Relative Rank	Normalized Weight (A)	(B)	(A)*(B)	(B)	(A)*(B)	(B)	(A)*(B)	(B)	(A)*(B)	(B)	(A)*(B)	(B)	(A)*(B)	(B)	(A)*(B)
Specific	5	0.33	0.33	0.1089	1	0.33	0.67	0.2211	0.33	0.1089	0.67	0.2211	1	0.33	0.67	0.2211
Measurable	2	0.13	0.67	0.0871	0.33	0.0429	1	0.13	1	0.13	0.33	0.0429	0.67	0.0871	0	0
Agreed Upon	4	0.27	0.67	0.1809	0	0	0.33	0.0891	0.33	0.0891	1	0.27	0.67	0.1809	1	0.27
Realistic	1	0.07	0.33	0.0231	0.33	0.0231	0.67	0.0469	1	0.07	0.33	0.0231	0.67	0.0469	0.67	0.0469
Time-Based	3	0.2	0	0	0.67	0.134	1	0.2	0.67	0.134	0.33	0.066	0.33	0.066	0.33	0.066
SUM	15	1		0.4		0.53		0.6871		0.532		0.6231		0.7109		0.604

Figure 21. The non-dimensional data techniques results[41]

	Plan			Risk Control		Change	
Method	LOB	CPM	RWP	Critical Chain	Decision Tree	ITIL	XPM
Rank	1	2	3	1	2	1	2

Figure 22. Alternative ranking[42]

STEP 6: SELECTION OF THE PREFERRED ALTERNATIVES

Based on the results of the calculation, I highly recommend LOB, Critical Chain, and ITIL methods.

LOB performance is 130% (0.6871 / 0.53 * 100) better than CPM and 172% (0.6871 / 0.4 * 100) better than RWP.

"LOB is a very powerful scheduling tool/technique and is especially useful whenever we are doing work which is repetitive in nature."[43] During the testing and preparation of a database upgrade, one test may go back to multiple other tests, with nested and recursive attributes between each test checkpoint. LOB resolve uncertainty in the repeatability test plan. For example, unit testing, integration testing, system testing, and factory testing can be well balanced.

The performance of the critical chain is 117% (0.6231 / 0.532 * 100) better than the decision tree.

"Both Buffers and Contingency are used to OFFSET or MITIGATE either time or cost risk."[44] In the Critical Chain, the buffer can coordinate multiple tasks such as device environment

[41] By Author
[42] By Author
[43] Example of Line of Balance by Guild of Project Controls Compendium and Reference (CaR) Retrieved December 2018, from http://www.planningplanet.com/guild/gpccar/introduction-to-managing-planning-and-scheduling
[44] Explains there are Two Approaches to Establishing Buffers or Contingency by Guild of Project Controls Compendium and Reference (CaR) Retrieved December 2018, from http://www.planningplanet.com/guild/gpccar/risk-opportunity-monitoring-and-control

configuration, data migration, and cross-regional data integration. Using Contingency also eliminates the risk of data corruption, loss, and disclosure.

The performance of ITIL is 118% (0.7109 / 0.604 * 100) better than XPM.

"ITIL's change management emphasizes the control of the changes necessary to the system while reducing the impact on service functions or project objectives."[45]

Database upgrade involves technical aspects such as network structure, middleware structure, database structure, application, storage allocation, automatic scheduling of batch jobs, etc. in the background, and a large number of scope changes will occur in these links. ITIL not only minimizes the uncertainty caused by scope changes but also guarantees the stability of the final system.

STEP 7: PERFORMANCE MONITORING AND POST-EVALUATION RESULTS

To better monitor performance, we can consider tracking performance according to the following steps:

1. Whether the uncertainty is solved well in each daily stand-up meeting.

2. Whether data centre consolidation plan to identify all the key risks.

3. Whether it adapts to the number of dynamic changes in test workload.

4. Whether it is continuously identifying risks.

5. Whether the impact of final on-line production on business availability is within the scope of the plan.

6. Whether the operating performance indicators of the production system are unchanged.

7. Whether the maximum business processing capacity has improved.

8. Whether the whole project is on-time and on-budget.

CONCLUSIONS

An important feature of a complex IT project: a high degree of uncertainty. It's the key to all the problems, and with this key point in place, the management challenges of complex IT projects can be solved. In particular, high risks caused by high levels of uncertainty require specialized risk management methods and processes; high levels of uncertainty place higher demands on

[45] ITIL Processes and Best Practices | BMC Retrieved December 2018, from https://www.bmc.com/forms/ESM_TL_ITIL_ReferenceBooks_BMCcom_EN_Apr2012_V2.html

the project's plans and require specialized methods and tools; Uncertainty is also largely due to a large number of scope changes in complex IT projects, so a dedicated change management process is required.

Now, we can answer the question raised in step1.

1. For complex IT projects, how to plan to deal with this uncertainty?

First, the detailed plan only covers the work tasks of the current stage and does not explicitly bind the next stage. Second, From the specific planning period, strictly follow the "week" as the unit, and only carefully arrange the specific tasks of this week, and only make extensive and extensive plans and budget estimates for the monthly work tasks. Third, at the end of each week, by the progress of the project schedule weekly meetings analysis project, we plan to implement the situation, summarize the progress of the emerging issues, and monthly target completion is expected to be controlled, whereby the formation of project work weekly. Finally, compare the difference between the planned completion status and stage objectives, and continuously update the plan with the stage objectives until the completion.

2. How do you classify risks for complex IT projects? How to identify risks? How to avoid risks?

First, at the beginning of the project, a project technical expert group composed of technical experts (including the manufacturer's technical support team and overseas expert team outside the company) and project management personnel was set up to take charge of the project's risk identification, risk assessment, and risk control Second, develop a risk response plan and take appropriate measures to deal with various potential and sudden uncertainties. Last but not the least, summarize the practical experience of risk management of multiple complex IT projects in the past, and form a unified project risk management standard within the enterprise, which will be solidified in the form of documents or rules and regulations to facilitate future project risk management.

3. How to apply ITIL change management to actual cases?

Involving changes in the scope of the project, strictly follow the process of changing the application form, and explain the impact of the change on the time and duration of the task before and after the change in the application form. After the change request form is established, the steps of the change request, change approval, change implementation, and change review is performed according to the project management specification, and the progress of the change is tracked to effectively control the scope change of the project.

Prospect

The research on complex project management methods is not for the best management method of this type of project, but the ultimate goal is to promote all project management practices and solve the problem of low project success rate. In my view, from the complexity of general projects, the classification of specialized complex project management, and finally return to general project management, has a long way to go, and is also the future research direction.

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