The IA Project

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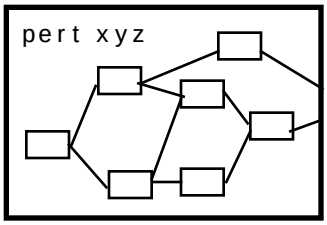


The Process

Software projects should never be late. They should be delivered on time, on budget, and on target every time. They almost always are, at software sites like IA Corp. Why aren't they elsewhere?

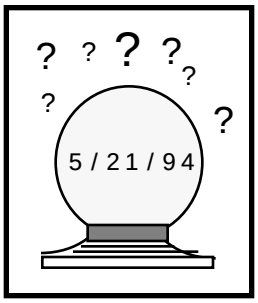
The answer is to be found in ***"The Process"*** , the way in which software projects are managed (or mismanaged) at the software site. According to the Software Engineering Institute (SEI), 81% of the software sites in the USA have no process at all. The SEI refers to those sites as "chaotic" and "anarchistic". By comparison to the SEI criteria, only a few percent of the software sites in the USA have a process as advanced as that of IA.

We refer to the process at IA, as "Uniform Project Management", or just "UPM". It is not about project management tools, although they are important. It is not about leadership qualities or the accurate calibration of each programmer's writing speed, although those too are important. UPM is about more fundamental things: the "three R's" of any software process. Repeatability is essential to the quality of the process. A software process can not be improved if each software project operates differently and according to the whim of the individual project manager. There would be no single process to improve. Reliability is the assurance that the process dependably applies to all projects, whatever the content or structure, and that the software site will in fact apply the process to every project. Refinability is the character of the process that permits more and more detail to be added so that the effectivity can be continuously extended and the quality can be continuously improved. There must be a way of measuring and adapting the process itself, as well as the software projects that it controls.

UPM achieves the "three R's" in many ways, some of which are more familiar than others. For example, UPM makes use of software planning tools. However, thousands of people buy planning tools for other processes or, more likely, for no process at all. The distinguishing features of a UPM-like process are the main subjects of this story. There are four.

1. **Closed-loop Control.**
2. **Role Refinement.**
3. **Process Independance.**
4. **Matrix Management of Project Life Cycle.**

UPM is a story in and of itself before mention of either the **object oriented core technology** of IA or the **proven level of talent and experience** at IA. Those factors are essential to the IA project. But they are the subjects of another story.

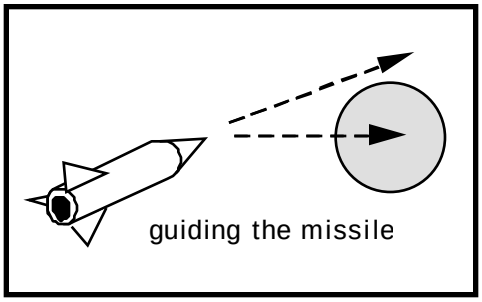


The Crystal Ball Fallacy

It has been said that software projects are always late; that there is an inherent unpredictability to software projects that will cause them to be late no matter how they are managed. The software project is too complicated to plan accurately. Time estimates are inherently unreliable. Unexpected events introduce unplanned delays. Important details of a design are unknown at the outset. The functional requirements change after the project has begun. In short, **no one has a crystal ball!**

All of those uncertainties, and others, do exist. But the unknown is not the problem. The problem is the management of the unknown. The fallacy is the assumption that a "crystal ball process" is the only way to manage a software project. There is another way.

The UPM process assumes that unforeseeable events will in fact occur over the life cycle of a software project. The objective of UPM is not to predict more accurately but to continuously correct for the effects of unpredictability.



Closing the Loop

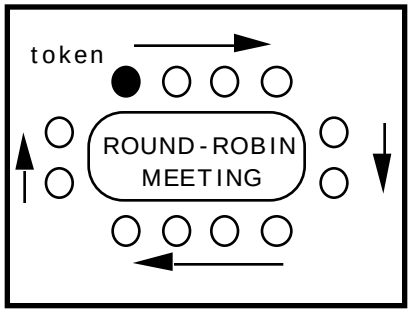
An "open-loop" control system is one in which the parameters of the system are set initially and never again adjusted or corrected as the system moves along the intended trajectory. After the initial settings, the system is on its own to either hit the target or not. A "closed-loop" control system is one in which the intended trajectory and the actual trajectory are continuously compared so that the parameters of the system can be continuously adjusted in order to correct for unpredictable errors and events. An example of an open-loop system is a dumb ballistic missile. The process is to aim, fire, and hope. An example of a closed-loop system is a smart guided missile. The process is to aim, fire, and then continuously correct the course until the missile is obliged to strike the target with great accuracy. The open-loop system assumes a very accurate crystal ball. The closed-loop system does not.

UPM is a closed-loop control system with a sampling period of one week. The control mechanism is the intitutionalized "UPM meeting" that occurs once a week for each project. The purpose of the meeting is to rigorously examine the current status of each project and to make adjustments to correct any time lost in the previous week.

A project cannot become several months late in the last month of the project. If months of delay were lost, they were lost a week at a time throughout the duration of the project. The purpose of the weekly UPM meeting is to compell the project members to react to the events of the previous week and to find a way to regain any lost time. If scheduling errors and unexpected events are noticed early enough, a wide variety of remedial solutions are available, including new technical ideas, technical redefinitions, reassignment of

tasks amoung the team members, addition of people to the team, task redefinition, and others. The project continuously and reactively "converges" upon the initial project commitments. Therefore, in theory, every project should meet its milestone dates within the accuracy of +/- one week. In practice, every project almost always does.

There are exceptions. It is possible to make mistakes that are unrecoverable or unnoticed until it is too late to react. Or, delays discovered in the past week may be unrecoverable by their very nature. Or, the change of scope of a project may, in fact, exceed the bounds of recoverability. In any of these cases, project delay is inevitable. The purpose of UPM, in those extreme cases, is to provide an early recognition of schedule slippage so that the client can be forewarned in time to minimize the effects or to decide upon trade-offs that could regain the schedule.



Elements of the UPM Meeting

Proactive Planning: Before the weekly UPM meetings begin, the project is planned much in the way of an open-loop system. The project is decomposed into individual programming tasks, each lasting a few weeks, which are then arranged on a PERT chart in the order in which they depend upon each other. The MacProject II project management tool is used to create and update the chart milestone and dependant dates and to assist in the critical path analysis. An important use of the tool is the creation of Gantt charts that accurately plot the time line of the tasks for each individual project member.

An example of each chart is shown in the appendix. The PERT chart is an excerpt of an ongoing project which extends part of the IA object oriented core technology for a new product release. The target is a heirarchical "object store" of magnetic and optical disk memory for massive network which handles several million documents per day. The Gantt chart is produced from the PERT and is used in the weekly UPM meetings.

Matrix Management: The project manager is not expected to be an expert at the UPM process. If he or she were, the process itself might undergo an improvement which would then require retraining and, sometimes, apprenticeship. The knowledge of the project management tools, and the UPM methods are the responsibility of a non-project person known as the "UPM'er". The UPM process does not supply the project manager with a training course in the process and an edict to use project management tools. The project manager is supplied a person who is already an expert in the application of the tools and the process. That person will actually simplify the life of a project manager, rather than complicate it.

Process Independence: The non-project status of the UPM'er serves two other purposes. First, matrix management permits people such as the UPM'er to specialize in the process. The process can then become more and more detailed and comprehensive without continuously encountering the barrier of training the technical project managers. Just as important is the fact that the career of the process specialist depends upon the continued quality of the technology process rather than the technology itself. Those two effects are the most important assurances of process refinability. They endow the process with a life of its own, independant from the pressing urgencies of the projects themselves.

Second, the UPM'er becomes a neutral party in the UPM meeting. There is no sense of recrimination in reporting problems. Each person should feel peer pressure but none should withhold the truth in fear of the wrath of an irritated project manager.

Project Formation: The proactive planning period is part of the project formation phase of UPM. The Director of Project Planning is matrix managed into projects and is responsible for the correct formation of all projects before they are staffed and set into motion. Project Formation is, at one time, the hand-off of a project from Sales to Operations, the "Guardian of the Gate" which prevents ill formed projects from entering Operations, and the proactive planning phase of UPM.

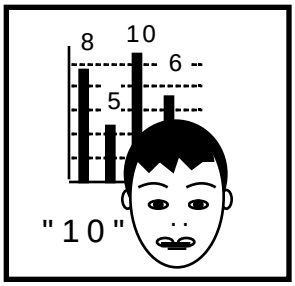
The proactive planning phase is highly matrix managed, involving the project manager, the UPM'er assigned to the project, and the Director of Project Planning.

Reactive Planning: After proactive planning, the UPM meeting closes the loop by analyzing and updating the PERT and Gantt charts on a weekly basis. The UPM meeting is rigidly formatted by the UPM'er. Each project member is interrogated, round-robin, as deviations from the individual Gantt charts of the project members are analyzed on a person-by-person basis. Although UPM'er is the person who identifies any schedule time lost in the week, it is not the UPM'er who identifies the solution. The project manager has the responsibility of insuring that the project members themselves find a solution. The UPM'er then revises the charts accordingly and distributes new charts to the project members before the next meeting. It is never necessary to totally replan a project each week but, if it were, total replanning would fall within scope of the UPM meeting.

Metrics: The primary metric of UPM is a spreadsheet called the EAC a spreadsheet which shows all project costs, materials and labor, through to the completion of the project. The EAC of each project recalculates actual and projected costs directly from the Gantt of the project. Therefore it is an extension of the Gantt and can be relied upon to be equally accurate.

Spawned and Imposed Meetings: Several other meetings are common place during the life cycle of the project. The project manager is free to establish regular meetings on specific technical aspects at any time. However, the UPM meetings is itself a source of other meetings. Impromptu task oriented meetings are called as needed. They are "spawned" meetings in the sense that they are created to solve technical or task assignment problems that arise in the UPM meetings.

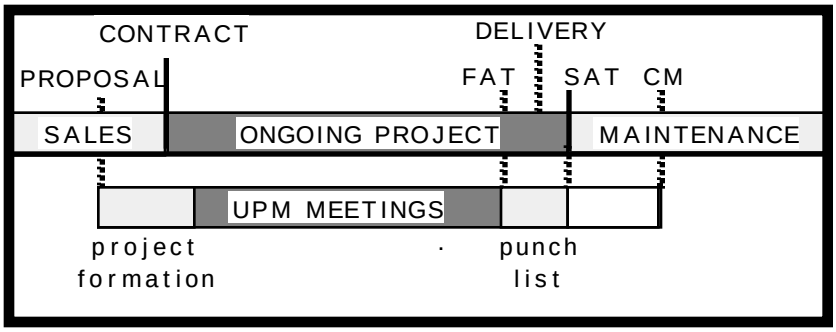
Some meetings are imposed by UPM itself. For example, the PERT for any project will show an event scheduled that is a design review. Other examples are Configuration Management, QA, specification requirements, documentation, etc. The "Imposed Event" is a way for management to make decisions stick. Changes to the UPM process are imposed upon the company by simply adding them to the charts. The UPM'er will then impose them upon the project members. The imposed event is one of the major mechanisms for refining and improving the UPM process.



Role Refinement

When picking a team, it can be more dehumanizing to think of someone as a complete person than think of her as a part of a person. A programming wizz may be disorganized, shy with peers, and brusque with clients. If you were to grade that person on a scale of 1 to 10, you might give her a 10 on technical talent, a 3 on management skills, a 2 on leadership, and a 1 on salesmanship. At IA, the grades are given on formal job categories called "roles". Anyone who ranks 10 on any formal role is assured career growth at IA. It is not necessary (and usually not realistic) to expect each person to rank highly in every category. It is more realistic to compose a team by matching one person's "1" to another person's "10". The team then has a practical chance of operating at an overall level of "10". Each person is invited to contribute in a specialized way according to her interests, talents, and background. Each person is treated more as an individual, with an individual personality, than would be the case if everyone were expected to match a standardized bureaucratic profile.

The role categories at IA include Project Member, Technical Leader, Project Manager, UPM Planner, Client Manager, Designer, Technical Writer, Proposal Writer, and several others. For example, the UPM Planner has a financial background and has no project duties other than to conduct UPM meetings. The Client Coordinator has the responsibility of communicating with the client, providing up to date progress reports when necessary, and coordinating the interactions of the client and the project team on joint efforts such as installation.



Matrix Management of the Project Life Cycle

UPM is a "cradle-to-grave" process in which each phase of the project life cycle is the responsibility of some group of matrix managed individuals who specialize in that phase. From their point of view, the project belongs to each of them, one at a time.

All projects are born somewhere in sales and belong to a salesperson The project formation phase begins when the client becomes ready to define a detailed proposal and includes such activities as the system design, definition of scope of work, costing, and determination of terms and conditions. Internally, within IA, project formation usually includes the first PERT Chart.

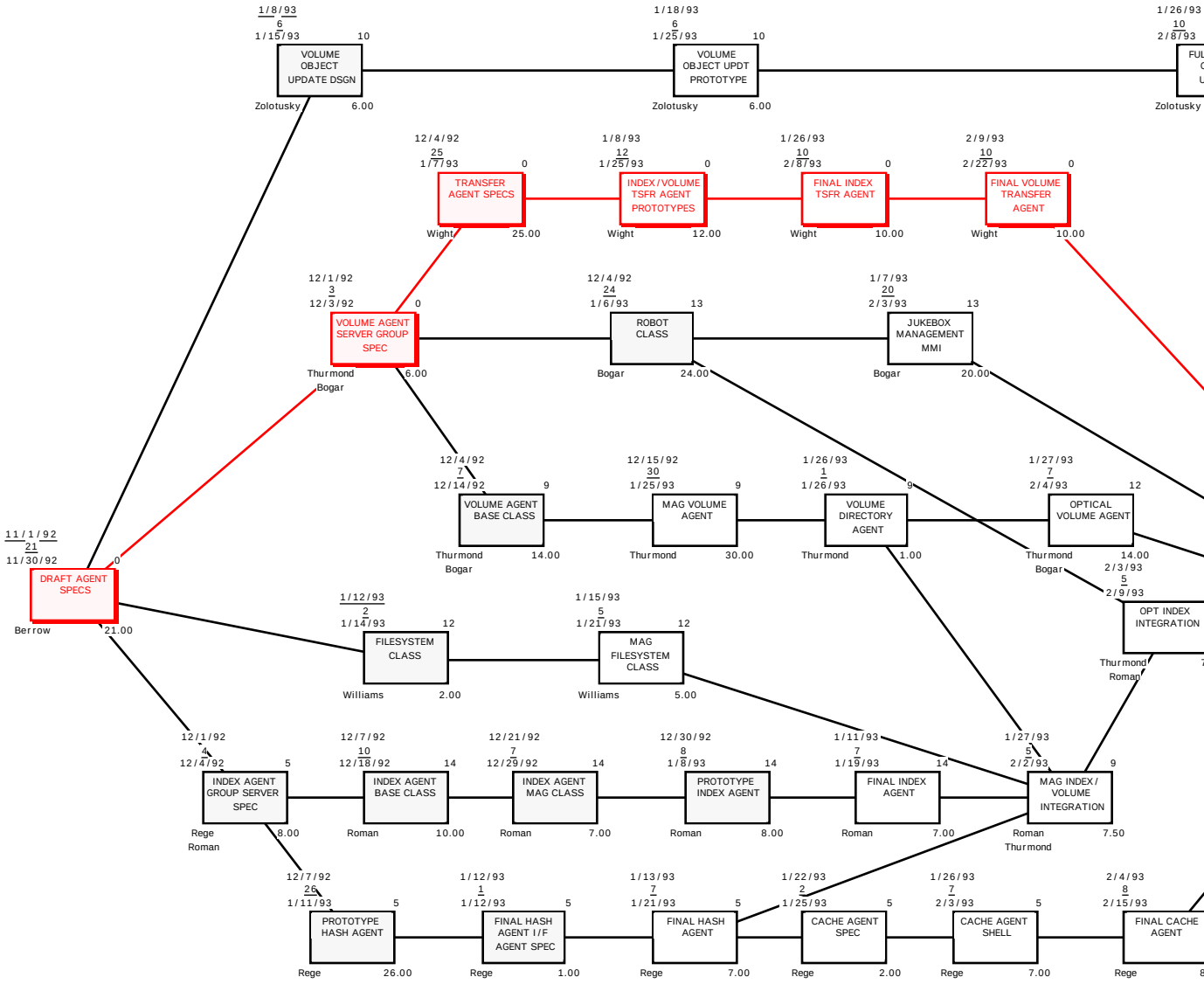
Project formation is also the hand-off of project ownership from Sales to Operations and the assurance that the project is correctly formed before it begins. The quality of a project begins before the project begins.

When a contract is assured, the PERT is completed to full detail, project formation terminates. and the UPM meeting begins. Through imposed events, the UPM meeting gives assurance that the version control and configuration management tasks will take place. The QA requirements appear as imposed events. The data design, testing, and acceptance requirements are imposed. In the end, UPM terminates with a hand off of the finished project to maintenance where it stays inactive and protected until some future project brings it back to active status.

Software methodology is independent from the process. Either the so called "waterfall" methodology or the "prototyping" methodology are both accomodated by UPM.

APPENDIX

Partial PERT Chart of an Ongoing Project



Partial Gantt Chart of an Ogoing Project