Managing Product R&D with Open Innovation - The Value of Project Management Practice[1]

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Abstract: Application of project management practice changed the Product R&D process that created a "Model" encouraging Open Innovation. The case study revealed how project management played an important role in shaping the mind-set of project engineers and business partners (contractors) involved in the R&D of a Satellite Navigation Terminal, and the Innovative Product R&D model.

Keywords: Open Innovation; Project Management; Product R&D; progress management; Product Development Life Cycle; Component Definition; Component features; Product Assembly; Virtual Assembly; Collaborative Development

1 The R&D model in modern China.

In the mid-50, Chinese Central Government was determined to transform the nation from an agricultural country into an industrialize country as quickly as possible. Being closed off to the rest of the world at that era of history, the government was decided to move ahead with a vision but lack of a clear path to achieve the final goal. They finally took the approach of "Plan, Execute, and Adjust" along the way. This approach is theoretically viable for delivering strategic outcomes (which is still being used to achieve its economic growth and political changes) and filtered into a tactical process for delivering objectives. This "Plan, Execute, and Adjust had become a culture since then, and become the **Do and Fix (DAF)** model that last for more than half a century in China for Engineering and Scientific works.

2 Projects Management Challenges

Project Management knowledge was officially introduced into China in the year 2000. The past 13 years, organizations were hoping this most successful scientific management knowledge developed by the West can help organizations reduce cost, reduce project time, deliver quality products, and minimize unnecessary wastage along the way. Unfortunately, projects cost continued overrun, deadlines continue to slip, and successful project deliveries were by brute force instead of scientific management. Project Managers recognized the challenge of managing the un-structured, repetitive, unmanageable DAF delivery model. They were unable to estimate project timeline, budget, work efforts, plan resources, track

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progress, and deliver quality deliverable. All project baselines were more a gut-feel instead of using various estimation techniques.

Figure 1: Generic R&D model & Do And Fix (DAF) model

Project Management is not simply adding management process within a project. It is a scientific management approach that needs to work along with a predictable, mature project delivery life cycle to be successful. As a result, most project managers failed his/her mission to manage project successfully, especially in Research and Development projects.

3 Managing the un-manageable

China joins the European Galileo Satellite Development program in 2005 with one of the objectives to learn the structured R&D processes as collaborative partners of the development program in a global development environment, and plan to create and develop related industry in China. We undertook development projects for validating of research thesis, development of operation support systems, related products and services for industry, as well as components development. Program governance requested stringent project management practice on all undertaking and it is recognized by all participants in China, mostly State-Owned-Enterprises that the necessity of delivering committed projects in time with quality to meet program timeline and managing DAF delivery model become one of the key challenges of this program.

A project office was created to plan, coordinate, monitor and report on all project status of project engagements. It is unfortunate that information received from project teams were lack of quality and substances that management was unable to manage projects effectively. With project teams delivering project engagement in the DAF mode, management soon realized that facts that 30% completion does not necessary mean 70% of outstanding activities, or remaining budget can see through the remaining workload. Effort estimation was un-realistic and delivery deadline were always hopeful with uncertainties. Risks were unable to identify and quantify. Managing all 7 initial projects became fire-fighting exercises every day.

4 The management challenges

To address management issues, priority was given to implement a standard project management methodology for all project teams. One of the challenges of managing DAF development process is to identify and structure processes within the project life cycle instead of repetitive changing and fixing of works required to achieve project objectives. Even though project milestones were identified at the beginning of the project, each milestone consists of numerous DAF activities since Milestones were developed based on project work breakdown structure (PWBS).

Studies indicated:

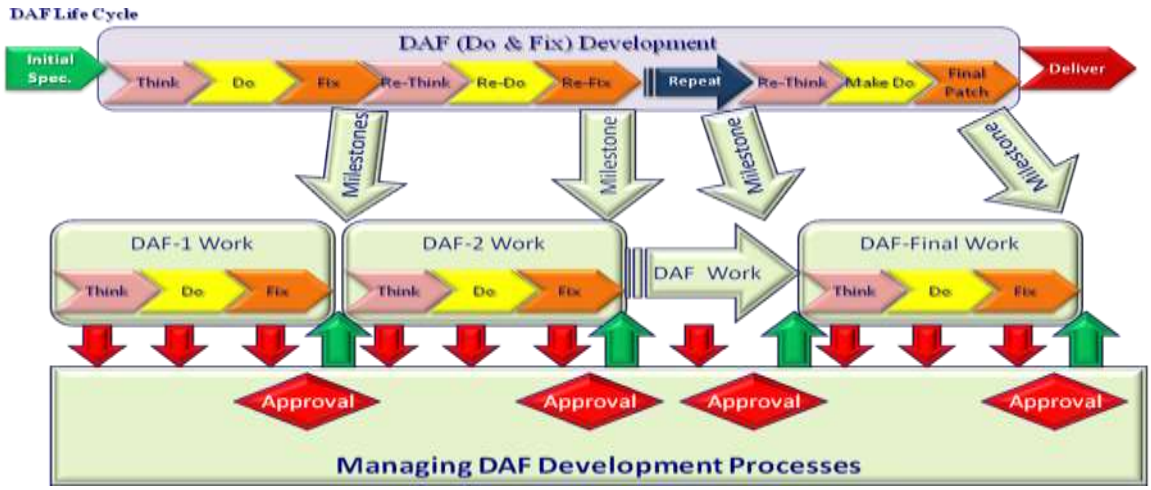
- the main reason for project not adhering to project milestones because of poor planning of activities at the project initialization stage, Resulting subsequent milestones being affected by the change involved for achieving current milestone deliverable. Comments received from Lead Engineers was that Changes throughout project life cycle will render initial plan invalid, and instead of spending time in updating plan continuously throughout the life cycle, might as well investing the time in getting the work done. Well, changes to Engineers' mindsets have to be introduced in order to manage.

- Project timeline and effort estimation was so rough that even though it was developed from PWBS, but it keeps changing along project life cycle for various reasons. Such project baseline continuously impacted by changes during development, and project cost, along with project progress reporting on variances become meaningless and does not provide a clear picture of the project status at any time.

- Lead Engineers frequently get drawn into technical details instead of managing and monitor projects. When technical problems arose, Lead Engineers tended to help Junior Engineers in resolving technical challenges instead of spending time identifying potential delay, additional cost, adjust schedule, re-assign resources, and develop alternative action plans. Lead Engineers become the bottle-neck of project progress when multiple technical issues arise from project teams.

As mentioned before, project success depends on a well structured process that project managers can reasonably predict its outcome. DAF approach needed to be structured to make it more predictable. By treating each "Plan, Execute, and Adjust" as one single work phase with phase end deliverable clearly defined, it is possible to change the DAF into a structured approach, only if each DAF span over a shorter timeframe.

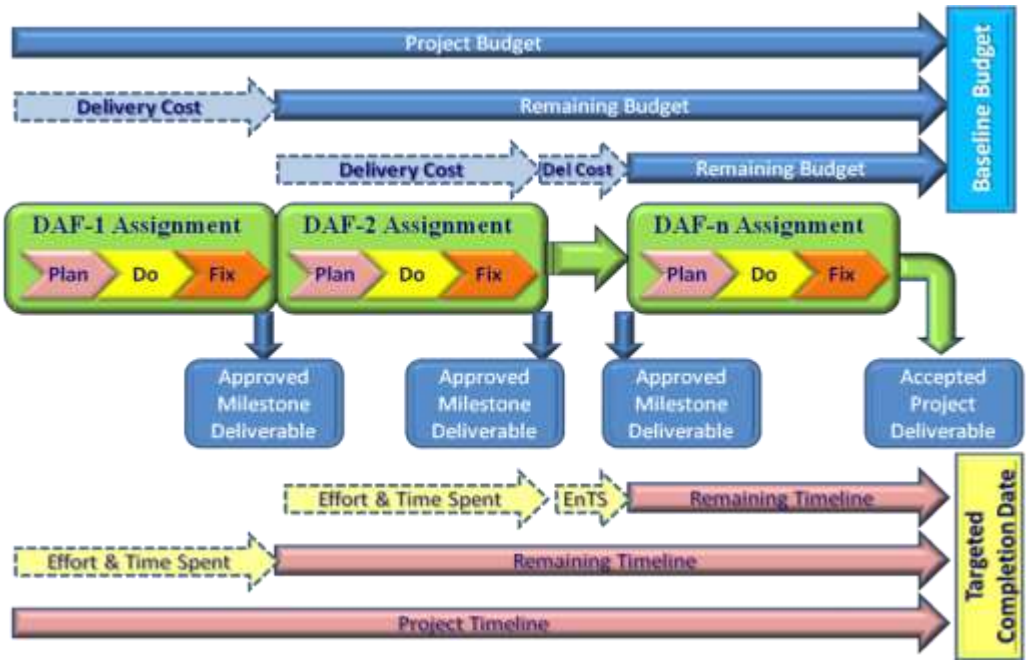
Figure 2: Structured DAF development process



Each DAF cycle becomes a project phase and at the beginning of each phase, Engineers must clearly define phase end deliverable which becomes part of the milestones along the project life cycle. A Lead Engineer (Team Leader) is fully responsible for each DAF cycle assignment, and must provides management a timeline, resource efforts requires to complete such assignment.

What really impact projects deadlines, especially in this DAF model, are not what had completed, but what is left to complete. Therefore our progress reporting changed from reporting effort spent to effort to complete. This also apply to project cost management, instead of managing what was spent, it changed to manage what is left to spend against efforts and resources to complete.

Figure 3: Cost and Effort Management under DAF model



Progress report on technical challenges that needs to be resolve no longer a problem reporting exercise. Engineers have to identify and recommend the approach they choose to resolve such problem, along and an estimate time-to-complete value for project managers to update project plan accordingly. Any impact to Phase end delivery schedule will alert Senior Engineers to support the technical team. Resources may be re-assigned, alternative solutions will be considered, and schedule will be updated to reflect the actual situation.

During each DAF phase, team leaders were requested to plan for phase activities to complete phase-end deliverables. Reporting by team members included two major categories: estimate time to complete for planned activities, and identification of unplanned activities with estimate time to complete. This will allow team leaders to analyse if unplanned activities were an oversight in planning; or redundancy work that needed to be terminated immediately without wasting anymore un-necessary efforts.

This management approach provides Senior Executives a better insight of project progress and status. At least each project phase can be identified if there will be potential delay, along with the forecasted completion date, and if additional budget is require. Yet it cannot avoid project overrun in time and cost.

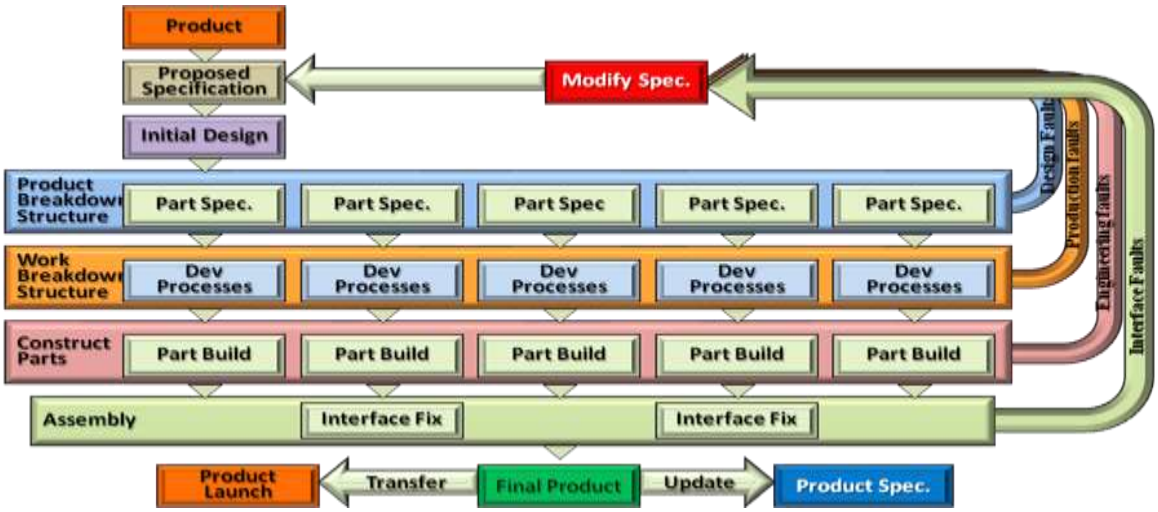
5 Evaluating the Product Development model

Management and Senior Engineers recognized the necessity of planning and forecasting future activities, which is essential to project success. Therefore we commenced an evaluation process of generic product development model and see how project teams can apply a structured development life cycle that enable better project management practice.

Product R&D projects are challenging because these projects always involved two major factors that caused changes along the R&D life cycle. Today's product usually covered many technical areas and subject matters that Design Engineers may not understand. Anyone involved in product development recognize the facts that initial product specification may be affected by the detail design of component parts, and the final assembly of component parts into final product.

Once the initial design was approved, change management play an important role during the research and development life cycle to ensure the final outcome meets its targeted consumer groups or customer groups.

Figure 4: Generic R&D Model Analysis



The Product Breakdown Structure approach used by Engineers to develop Parts Specifications were based on concepts and visions, that the actual design of parts by engineers from various technical disciplines may find it impossible to produce the desire components based on existing technology and tools, that it may cause change to original product specification.

The Work breakdown of component parts that covered various technological fields may be difficult to procure or manufacture, thus causing change to its original product specification once again.

During the manufacturing or construction of component parts, technical challenge may once again delay product launch or caused further changes to the original product specification.

During final assembly of the products, component parts may have integration and interface problem that caused specification changes again.

Most problems from the generic model studied indicated that detail design by Design Engineers down to part level was impractical to achieve the desire result.

The Product Breakdown Structure down to parts level also distorted the Engineers' vision from identifying what is available from existing market, which can be purchased instead of custom build.

Engineers may require extra time to learn new technology that needs to be integrated into the product, extending development timeline for timely product launch.

All these continuous changes and technical challenges for producing proper component parts for the final product assembly became too detailed and massive to manage, and really have no differences from the DAF model used by Chinese Engineers.

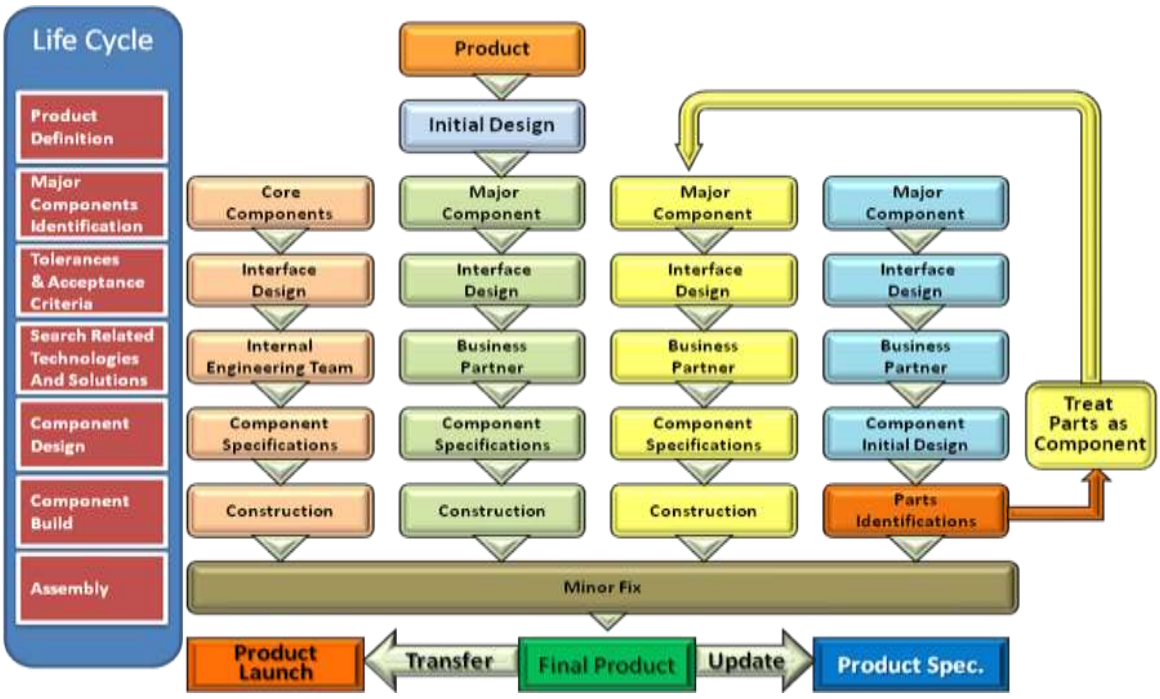
6 The Open Collaborative Alternatives

Since most of the detail design of component parts was too detail and complex for Design Engineers to master all related technology and construction processes, therefore it is more practical to consider defining high level product components that had specific purpose, with specific functions defined that contribute to the final product.

Initial product definition (overall specifications) and physical design of the product was broken down into major components. Instead of learning new technology and develop specific components parts ourselves, we searched for business partners that have the technology and knowhow to produce our product component to work with us on the product development.

Instead of facing the integration problems during product assembly, we defined component interface specification and managing those interfaces to minimize changes caused by component assembly and integration.

Figure 5: Open Collaborative R&D



Design Engineers further defined a conceptual appearance of each major component, and our acceptance criteria of those components that formed a key part of our final product. Core components

7 The Final R&D Model

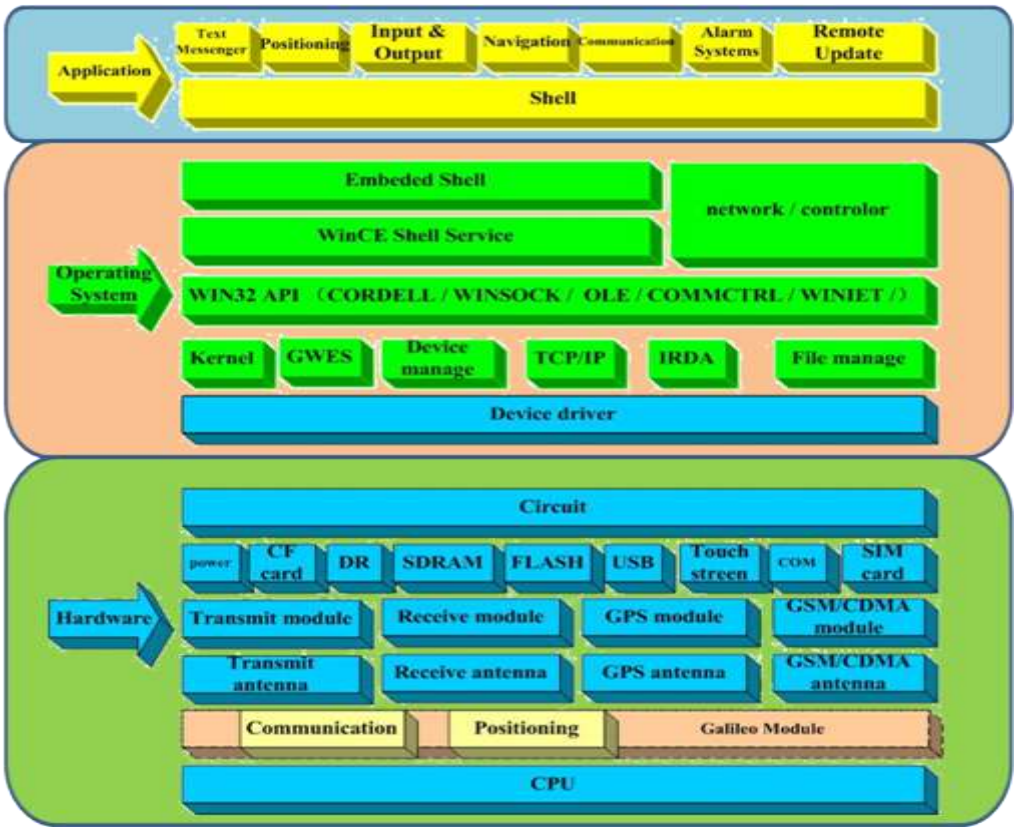
In early-2006, a new project was initiated to develop a palm size hand-held navigation terminal. It originally planned for a 24 months project life cycle and Senior Executives

decided this was the right project to refine and test out our Open Collaborative Development theory.

Product Manager and Design Engineers determined that the product should be broken down to three component-projects; "Hardware", "Operating Systems" and "Application" respectively.

Each sub-project with major components further defined and core components to be developed in-house were identified to protect product pattern and Intellectual ownership. Other components were sourced from business partners (within and beyond the group of companies) with Requests for Information (RFI) initiatives.

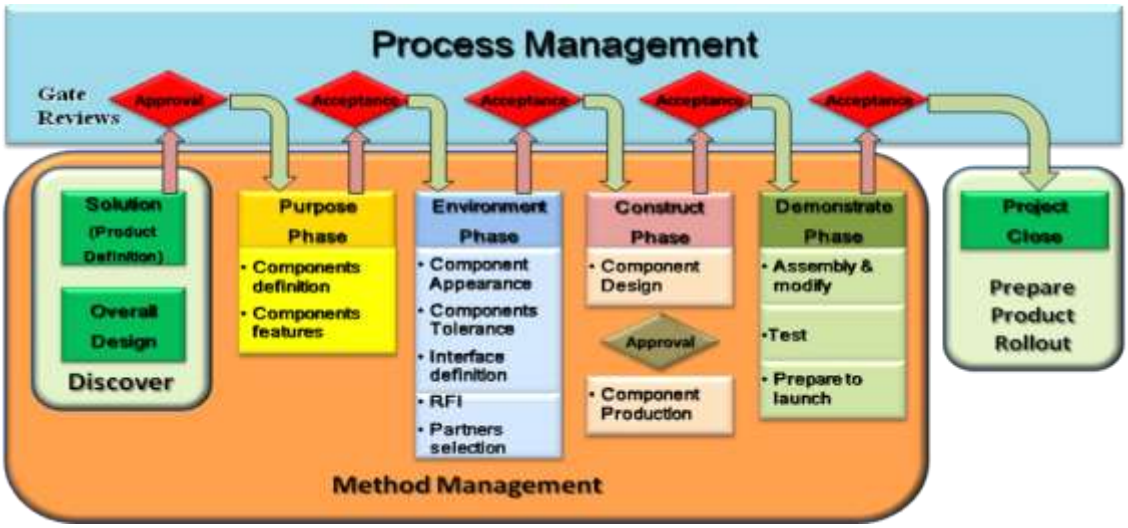
Figure 6: Major components of palm size navigation terminal



A Technical Committee consists of Product Manager, Design Engineers, Business Managers, QA and Project Engineers, together determined and select the business partners for each of the component-project while the project management office brief all business partners on our management process and related governance issues.

The R&D life cycle was further defined into various phases, and phase-gate reviews and management processes were introduced for the technical development.

Figure 7: Final Open Innovation R&D Life Cycle



For components that are too complex to be developed by any individual business partners, sub-components were further defined and RFI were sent out in search of related business partners to design and construct the sub-component for assembly. The Sub-component Lead Engineers will define and determine acceptance criteria, features definitions, as well as interface definition.

8 The End Result

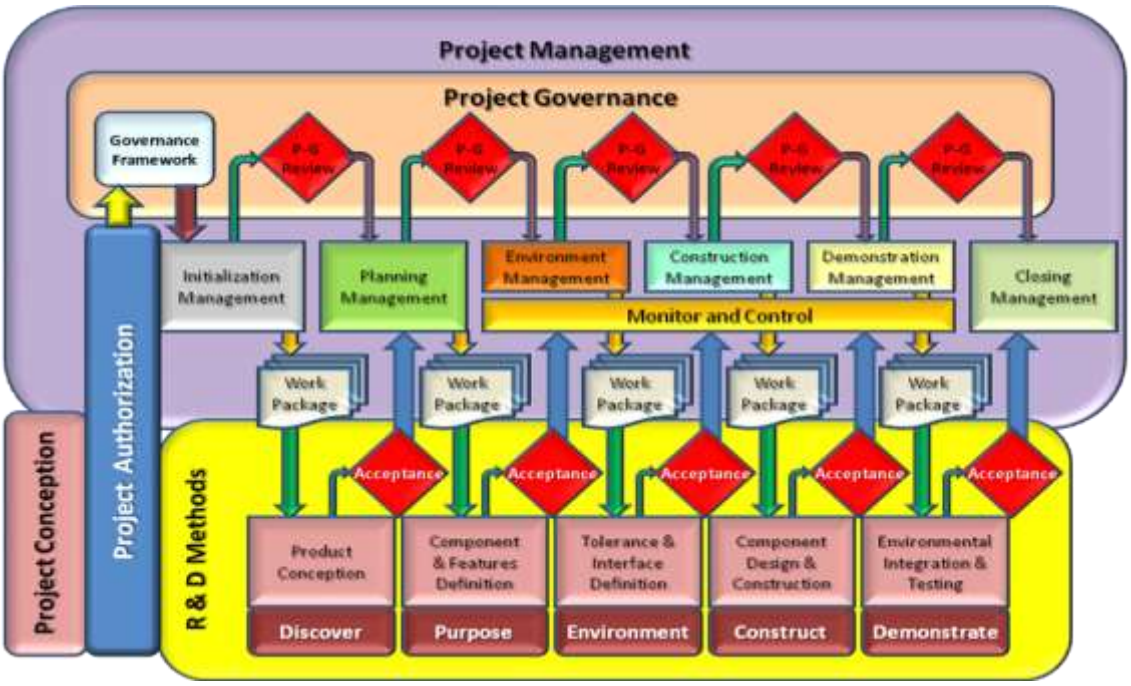
The progress management continue to use the DAF approach of managing yet-to-finish workload by defining each major component as an independent work package. Each work package can be broken down to work assignments for small work groups or individual engineers that defined activities, baselines, deliverables and acceptance criteria.

Originally planned for 24 months to complete, the final product were ready to roll out at the end of 17th months. Overall cost for the product development was 28% below our original budget.

Senior Engineers were able to spend more time in evaluating component design instead of designing the component themselves, that enable them to identify potential integration problems prior final assembly. At the end, only two major components require minor modification before the final integration to the product.

Most of the time and cost saving was a direct result of design works transferred to business partners and internal learning processes by Engineers on new technology.

Figure 8: The R&D project management model



While we are still measuring overall benefits of this Open Innovative R&D model, we are refining this model into Software Engineering (based on lesson learnt from the Operating System development and Application development) model for software development, as well as encouraging our software industry to develop virtual assembly modules that simulate component assembly after CAD (computer Aided Design) and prior CAM (Computer Aided Manufacturing) activities.

Project Management, is more than completing project deliverable in time and within budget. It is the driving force behind technical process improvement, and eventual innovation.

About the Author

Professor Hubert Vaughan (Retired)

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Hubert Vaughan commenced his career in the field of computer technology in early 1972. For thirty years, Hubert practiced and served a number of International technology and financial Organizations including IBM, DEC, Unisys, Tandem, Bell Canada, Andersen Consulting, Lucent Technologies, National Mutual, ANZ Banking Group and Bank of Montreal; holding senior management positions in Technology related services. His career covered the five major continents around the world as Department Manager, Director, Assistant Vice President, and Vice President that spanned across software development, professional services, product development, technology consulting, project/program management, strategic planning as well as business development.

The last ten years, Hubert joined the Academic Institutions in China as Professor at the Institute of International Engineering Project Management (IIEPM) of Tsinghua University. Hubert also lectured at the Graduate School of China Academy of Science, the Beijing University of Aeronautic and Astronautic teaching Innovation Management, Management of Technology, Program Management, Project management, and Software Engineering.

Apart from his teaching engagements, Hubert is a Research Fellow at the China Academy of Management Science, a member of the International Society of Professional Innovation Management (ISPIM), a former member of PMI's Certification Governance Council (CGC); a co-founder of First International Innovation Management Alliance (FiiMA), and an Editorial Advisor of professional e-journal PM World Journal. Hubert is a Program Consultant to a number of multi-billion dollars projects run by State-Owned technology organizations and financial institutions in China.

Hubert is a regular presenter at international conferences and seminars in North America, Europe, Middle-East and Asia-Pacific. He had published more than fifty papers related to Software Engineering, Project Management, Program Management, and Innovation Management subjects both in China and in various international professional journals. Retired from his academic engagement in July 2013, Hubert continues his research work in Innovation Engineering and presents at international events about his research findings throughout his career. He can be contacted at hubertvaughan@gmail.com