Doing business today is not the same as 60 years ago, or 40, or even 20 for that matter. It is much more competitive and globalized, and the nature of IT solutions changed along the way. Instead of supporting business operation for efficiency and accuracy during the “Automation Age”, it becomes a management tool to decide on investment and market share during the “Information Age”. Today, we are looking at developing software to search for market opportunity and product behaviors for sustains growth and profitability. We are indeed stepping into a new era, the “Innovation Age” of information technology.

IT projects today frequently includes technology the development team may not acquire such specific knowledge, thus engage external expertizes to work on such onetime activity. It will incur certain risk elements when focused around collaboration, co-operation, outsourcing, and procurement during project delivery. The change of project activity requires project managers to change their management approach in managing their engagement in order to have a better chance of success.

What Project Managers manage in “Reality”

Project Managers manage projects, of course. But what is a project? According to Project Management Institute (PMI), it’s a temporary group (of) activity designed to produce a unique product, service or result. A project is temporary in that it has a defined beginning and end in time, and therefore defined scope and resources. And a project is unique in that it is not a routine operation, but a specific set of operations designed to accomplish a singular goal. So a project team often includes members who don’t usually work together – sometimes from different organizations and across multiple geographies. The development of software for an improved business process, the construction of a building or bridge, the relief effort after a natural disaster, the expansion of sales into a new geographic market — all are projects. It must be expertly managed to deliver the on-time, on-budget results, learning and integration that organizations need.

Therefore, project managers are supposes to manage “activities” designed to produce a unique product, service or result. If “activities” are not designed in an effective and logically manners that leads to the completion of such unique product, service or result, no matter how well the project managers apply the knowledge, skills and techniques acquired from the PMBOK Guide, projects will fail.

1 This series of articles is by Professor Hubert Vaughan, recently retired from Tsinghua University in Beijing, and is based on his research over the last ten years during which he has developed some new approaches to managing major information and communication technology projects.

2 Guide to the Project Management Body of Knowledge Project Management Institute 2004
The early breakdown of a project structure since the very early day of project management still holds truth today. Project can be delivered through the completion of one or more “Stages” or “Phases” of events, each consists of one or more “Activity” logically arranged in parallel or series, that requires specific resources to assigned to one or more “Tasks” arranged in logical sequences. Depending on the resources, budget, and time available, project managers will determine the best compromise to structure his/her project engagement in order to meet customer’s expectation and satisfaction.

How we do business dictates the way how project is structured because it can change the dependency of our project activities, which is also known as Project Life Cycle (PLC). It can impact the project plan, time to completion, resources, budget, and overall risk. Successful project management depends on the ability of the project manager to arrange and manage “all activities” during project engagement. All those knowledge, skills and techniques inside the PMBOK Guide help us manage each and every activity during project delivery that leads to the final deliverable. This is one of the major reasons why PMBOK Guide can apply to all projects in most industries because the same knowledge, skills and techniques are applicable to ALL Project Life Cycles. And one of the main reasons Corporate prefers to hire project manager with knowledge and experience of similar industry, because this project manager is expect to know if project activities are properly arranged (Plan) during project engagements.

**Automation Age - Early IT landscape and Information Behavior**

Computing technologies and software development played a major role in re-shaping how information behaves in our commercial establishments. The “user requirements identification phase” dictated the design of computer-based systems in the early day, and
managing user requirements is one of the key success factors in software engineering project management.

Before the 1980s, organizations develop software for the purpose of managing business processes and commercial data in order to gain competitive edge of operational effectiveness and efficiency, minimizing human intervention and potential human errors to reduce operation cost. The development focus of software was changing manual processes into computerized processes and is known as the “Automation Age”. It is a period of technology utilization, by understanding how the manual process delivers business objectives. “Terms of Reference” set the boundary of project engagement and users requirement, were the analytical outcome of the business processes that needs to computerize, formulated by software engineers (Refer to Second Edition Section of PM World Journal this month – Where to look when Requirements do not exist in today’s Software Projects - Hubert Vaughan).

Most frequent used development methodology by software engineers was the Information System Development Methodology (ISD), Waterfall Development Methodology and Structured System Analysis and Design Methodology (SSADM) that focused around understanding the business processes and modular structure of the solution, i.e. the system. Managing software development during this era of automation age simply ensures effort estimation and development progress falls within the allocated resources and timelines. Such responsibility usually falls onto the Senior System Analyst of the development team. There was no proper project management methodology for the industry except using Program Evaluation and Review Technique (PERT) and GANTT charts that help team leader to identify project progress. PMBOK draft document was not published until 1986 and the First Edition was only released in 1994.

System testing was conducted by the developers ensuring all user requirements identified during the initial learning of the business processes (fact finding phase), and the subsequent application system (design phase) that formulate the application architecture does deliver the expected logic and data for departmental operation purposes.

Users Acceptance Test was conduct by users who used to perform the manual tasks ensuring the overall application system as a whole does perform and deliver proper result as per the manual processes. Departmental staff members was the de-facto Information owners ensuring data accuracy and consistency, as well as being able to provide upper management operational details of their routine operation.

In this era of Automation Age, successful software delivery started with knowing the system can deliver the end result same as those of the manual system. The only proof for IT practitioners to ensure it deliver the system meeting “user requirement” is to plan for and eventually set up parallel run testing environment demonstrating both results are equivalent.
Information Age - From System focus to User focus

Information accumulated for decades before the 80s provides business managers with statistical details of their management effectiveness. Then the world’s energy crisis in the 70s and early 80s encouraged organizations to improve coordination of information and look for ways to further streamline their operations by eliminating redundancies, improve data integrity, avoid duplication, timeliness of business processes and data gathering. Decision of technology application depends largely on its Return of Investment (ROI) and the common expectation of technology application needs to improve management ability within departmental operation. Apart from the traditional computerization of manual business processes, new projects were created to consolidate and integrate existing information. Management was paying more attention on their information needs and how information was delivered for their own benefit. Management gradually took over information ownership from their operational staff.

In the early 90s, User Requirement was more difficult to define. Introduction of Statements of Works (SOW) replacing Terms of References to define project boundary does help in new software development, but failed miserably for system integration and data consolidation projects because there were no pre-defined processes to follow. The focus of fact finding continues to be on operational staff that had no answers to all the questions during fact finding exercises. It is this period of time that Rapid Application Development (RAD), Computer Aided Software Engineering (CASE) tools, and Fourth Generation Language (4GL) appears that encourage Do and Fix approach in Software Development. IT practitioners failed to understand that it was not the development methodology that caused IT projects failed; it was our misunderstanding of information ownership and our failure to define project scope that caused project over-run.

Information technology and business entities took the whole decade and beyond in the 80s to transform from the Automation Age to the Information Age. The paradigm shift of Information Behavior from focusing on the system to the users and their characteristics impacted software development methods and how software development was managed during the last 20 years. Business managers expected software enable them identify areas of improvement and cost saving, and investment on Information system projects aimed at delivering value through technology application. The failure of understanding information behavior by the IT professional leads to the many failures of system development in business organizations.

When Information Age came into full force from early 1990s, software were focused on strengthening management ability in all disciplines within an organization, from manufacturing to marketing, supplies and services oriented operations. It takes many shape and forms like Enterprise Resource Planning (ERP), Customer Relation Management (CRM), Supply Chained Management (SCM), etc. Successful implementation of these types of Information Systems requires a thorough understanding of how information owners (management) wish to utilize information to manage their operation. It was unfortunate that most IT practitioners tried to secure management’s mind-set from their operational...
staff during fact finding exercises, causing deliverables not meeting management expectation and continuous project over-run.

The convergence of information and communication technologies was an enormous leap for people of the modern information society, and creates additional opportunity for failure in software development. We continue to ignore the fact that only the information owners are the only one that can help us to define project scope, reasons of investing on the software solution, and the expected outcome of the software. Project managers should work with information owners to obtain proper expectation and investment objectives, create the roadmap that derives user requirements, of which their operational staffs are unable to provide. Such “code and fix” phenomenon is also reflected in the tools available for recent date software development.

We may argue that Project Charters does define management expectation and value of technology application via ROI statements. The gaps between the project charter and the development processes (methodology) deployed by organization, and the activities focus of compiling project charter and delivering project deliverable is getting wider and wider. Information owners (management), information providers (operation staff) and information architects (software engineers) are not in coherence nor integrated in the development processes, causing our current state of failures for information system development.

Successful project management of any information system started with a well-defined acceptance criteria at the start of any Information System project. Instead of diving into defining user requirement at the start of a project, the project manager should work with the de-facto information owner (management) to draw up a well-defined acceptance criteria of final delivery. It is the only way how project managers can understand the user’s (management) expectation and the mind-set behind the software investment. Managing Acceptance Criteria instead of user requirement have a better chance of winning customer’s sign off sooner.

Innovation Age - The Next Generation Software

I was involved with two different software development projects in two organizations in 2008 and 2009 that last for 18 months. Each organization belongs to a different industry, have nothing in common in terms of market sector, customer profiles, and product properties. Within a period of twelve months, software development projects were initiated from these two organizations with a vision to utilize existing information portfolio captured in past operation to help the organization to innovate for market leadership.

The first example involved a telecommunication carrier who is trying to develop an application that can make use of information captured during the past, as well as search through the public internet domains to select relate dataset available, to create a repetitive model supporting future development of new product, identify new market, and discover new services to customers so to remain competitive.
It was part of the business strategic objectives of senior management that past operational
details, and information cumulated, along with the huge amount of information available
from the public domains over the internet, should provide insight of their past success and
failure. The company should have the appropriate tools to make use of such information for
future product and service development as well as market penetration.

The second example is an engineering organization aimed to develop an application that
can highlight potential technology improvement and new product development, by
analyzing performance data of existing products in services and similar technical details
across the public domain.

Today’s applications are expected to deliver new business objectives that have no prior
process available, and no precedent within the organization. Scope Identification become
more challenging if not impossible. Since it is a new business initiative, therefore we can no
longer conduct “Fact Findings” phase in our project life cycle as we did in the Automation
Age and Information Age because there is no fact for us to discover. Project Managers have
to consider an alternative to Face Finding by Exploring the necessary “Process Road Map”
that leads to the final deliverable.

Exploration of “Process Road Map” is similar to business process development, by creating
foot-prints of what needs to do with the system until we get what we want. Instead of
manual processes in the business process development, we focus on information processes
instead.

The use of information from internal and external sources to deliver project objectives that
enables operational management to identify opportunities to innovate, and gain
competitive edge over competitors. The mapping of internal information, external
information, and strategic objectives are the key success factors of this type of project.
Information retrieved needs to be filtered, consolidate, analyze, and compare their normal
and abnormal pattern of behaviors (with baseline drawn from internal information) related
to the strategic objectives will constitutes to the exposure of potential opportunities.
Innovation opportunity and strategic objectives are further divided into potential market
segments, technology enhancement, product, services and operational processes (Methods)
 improvement.

Innovation objectives have a tight relationship of business strategy. Potential opportunities
must map innovation objectives, which requires further breakdown of focus of innovation
development such as new products, new services, and/or new market catered for the
potential customers, new technology or review and enhance the management processes to
streamline the operation.

The two sampled development projects mentioned indicate that it is the search of
“Opportunity” perspectives that we are experiencing, and exploration of Opportunities will
migrate the IT industry from the “Information Age” to an “Innovation Age”. We are
experiencing another paradigm shift of information behavior, from the current user
perspective to a potential of client perspective. This paradigm shift is brought about by
recent changes in scholarly publishing, which enabled end-users to search for and retrieve information by themselves for their own purpose. Next generation software is expected to look for opportunities from existing information (both internal and external) for new products, new markets, new customer group, new services, new technologies, and new management processes.

There are many good examples from the Apps Store for our Smart Phones, in areas of Entertainment Apps, Travel Apps, etc., and certain Apps integrated with proprietary products such as Navigation Apps that included points of interests. These products require data from the public domain with internal processing function to create the final product for consumers. This new paradigm shift is arriving sooner than expected because of the current economic slowdown and market competitions are acting as a catalyst of the transition. Organizations that accumulate huge amount of information during their past operation are going to drive value out of these assets. How will this Innovation Age affect future IT projects and how can we manage these projects is something we must look into in earnest.

It is very likely that other industries may follow suit, such as telecommunication service carriers, financial institutions, public transportation services, utility services and others that used to cumulate huge amount of operational details during normal business operation.

**Identification of Deliverable**

Unlike Automation Age where we can manage the scope to deliver our project, nor the Information Age when we can define “Do what” in our SOWs that allow us to meet our project goal. Instead of managing “What we do” (Scope), we have to focus on “What we deliver” (Deliverable). Innovation Age demands something totally new by the Project Sponsors, Stakeholders and Users that the technical team may not have the faintest idea of how to deliver. Only if we can identify what to deliver in our project, we have no choice but to “develop, verify, modify” cycle which is very much like the “DAF” (Do and Fix) model commonly use in China for many years (Refer to “Open Innovation – Managing Product R&D Projects” in the Second Edition Section of November PMWJ). It is exactly most project managers are doing today because they are trying to focus on “Do what” instead of “Deliver what”. It sounds familiar to most because we had done this before in the Information Age. Oh! Yes, the 4GL era and the so called Rapid Application Development during the Information Age.

You will be able to find out some methodology in my Second Edition Section “What to look for when Requirements does not Exist” and “Project Components Decomposition”.

**Managing the Engagement Life Cycle (ELC)**

Few project managers aware of the value and benefit of reviewing and confirming Project Life Cycle (PLC) before project execution. The PLC is the first clue if the project can be completed on time, within budget, and with available resources. It is the first thing a project manager should think about when receives his/her assignment because it is the root of any planning exercise that follows.
Project engagement consists of the logical phase of project engagement (Development Life Cycle, DLC) and how each and every phase is being managed (Management Life Cycle, MLC).

We are talking about the System Development Life Cycle (SDLC) when we talk about IT projects. Most project managers continue to apply the generic Waterfall Development Process (Waterfall) or modified version of the original Waterfall during System Development. The generic SDLC processes included “Scope Identification, Fact Finding, Analysis, Design, Develop, Test, and Deliver”, which is also known as Stage or phase which must be executed sequentially and logically.

Then we also have the Management Life Cycle (MLC) that consists of recurring process group in the SDLC process specified in the PMBOK Guide.

Depends on the management style of the project manager, and the availability of time and resources, one may choose to review and sign-off each and every Development process before initiating the next, or commence Initiating and planning the next Development process while monitoring and controlling the current process so that subsequent development process can start executing once the current process is closed.

The Project Life Cycle, (which I prefer to call Engagement Life Cycle ELC) provides a bird-eye view of project risk of interim deliverable at the end of each development process all the way through to the final project deliverable. If a project manager cannot execute and monitor activities that are arranged in a logical manner when it is plan, you have no hope to deliver the project successfully no matter how good you are using the tools and methods described in PMBOK Guide.

Why is the Life Cycle so important? You may wonder! It is important because it represents how your projects are being delivered, in a logical way, that if you may face with certain risk in each of the process phase. The Life Cycle will also enable you to analyze if you can improve the team performance or expedite your delivery by possible modification (Also see

Managing the Project Components

What are the differences between Modules and Components in an Application? Generally when we design a module for a computer system, we group “similar functions together” that subdivide a system into smaller parts (Modules) that can be independently created and then used in different systems to drive multiple functionalities. It is functional partitioned into discrete scalable, reusable modules consisting of isolated, self-contained functional elements³.

It enables us to overcome changing customer demands and to make coding process more adaptive to change. It is supposed to simplify future maintenance and enhancement. However, the high cost of creating module interfaces discourage its original design objectives since we have to manage data-flow for multiple functions and algorithms that create havoc in designing Modular interface. Tracing and tracking interface are nearly impossible after a couple of maintenances and modification.

³ Wikipedia on “Modular design” – http://en.wikipedia.org/wiki/Modular_design
Components, on the other hand, only group related operation processes for just ONE single function together. Compare to the Modular Design, experienced coders or programmers should have no difficulty in delivering the final outcome. However, when we are dealing with external coders who may or may not have the necessary experience to deal with complex modules, will find it easier to deliver components instead of modules. Back in 2009, we did a controlled test by separating the classes into two groups, one group responsible for coding the Module while the other group responsible for coding components. Each group had 8 hours to deliver their assignment. While the “module” groups have more problems surface during acceptance test and take an additional 36 hours to modify the modular logic and interface data, the “component” group delivers the perfect result at the end of coding using only 8 hours. Of course, further test is required to validate this theory but given the simplicity of components compare to the complexity of a module, it is quite obvious that this theory will hold true.

Modules can be a complex task when defining quality and creating Acceptance Plan. It is also a challenge to the development team Leaders as well. Components’ quality is to achieve the coding objective by taking into data input, processes, and data output, back to the original Data Processing concept in the early day. Life can be so much merrier and simpler.

During the Automation Age, project scope can be identified without too much difficulty; it is simply a replacement of manual business operation by a computerized solution. Identifying the start point and the end point of a manual business process is rather straight forward, the scope can be locked down and the risk of failure for this development process is minimal. Overall development processes are logical and proof to be a solid methodology for IT projects.
During the period of Information Age, when organizations are consolidating departmental data for effective corporate management purpose, the Statement of Works (SOW) with inclusive and exclusive statements can deliver a clear identification of project deliverable. Some of the development out-sourced may create certain management problem, yet it is still manageable in a sense that we know what to deliver.

Into the Innovation Age, project sponsors and stakeholders want to have a system to achieve a vision, as such, the modular design requires more patching at the end than the simple component design. What’s more, if the component was not serviceable, we can dispose of the component and develop a new one, instead of doubling the time for final acceptance before delivery. There is no future maintenance necessary because we can dispose of the existing component and replace it by a new one. New Components can be developed if new function is needed. All we need to manage are the Component Interface ensuring data integrity and accuracy.

**Speed to Market**

In order to be competitive and lead the commercial market, Project Life Cycles are getting shorter and shorter. We don’t have the luxury to deliver all functions and features during project engagement. Furthermore, we may not even have the time, and the resources to conduct a thorough test before releasing the product. We have no choice but to utilize our users or consumers to help us on quality and product improvement. Establish a “User/Consumers” Feedback and product improvement program so that we can continue to upgrade, or improve our product line.

This philosophy holds true only for consumer oriented products and non-mission critical solutions. For mission critical products, such as financial products, aeronautics, astronautics, pharmaceutical products, we still have to oblige to the standard guideline of the corporate or the regulatory bodies.

**Managing business partners or collaborators**

Once we confirmed the ELC and the time we have available for our development, we may discover certain technology, be it hardware or software, may require subject matters beyond comprehension of the development team. Depending if the missing technology is part of your core elements of your product, or something you can easily procure from the market. You may decide if business partners or collaborators may be a better alternative to join the development team so that you have the right resources for the development, or you can simply procure or outsource such components to external organizations.

You may also consider if your organization may wish to own such components of the technology that your business partners or collaborators are working on in our engagement, or waives the ownership of such components within your project so that you do not have the “Intellectual Property Right (IPR) of those components developed by your business partners or collaborators, Or shared ownership of such IPR.
Managing Procurement and Outsourcing

Just a matter of minimizing your resource requirement, or maximize your team performance, you can either procure or outsource certain components to external organizations.

During the Information Age, we procure or outsource “Modules” to third party. Since it involve complex logic and Modular Interface Design, a lot of patch up work is require during integration testing that render the original specification obsolete.

Procure or Outsource Components are much simpler because components are function partitioned and the logic is straight forward. Proper design of the Component Interface will minimize most of the patch up we face with during integration test.

Negotiating the Intellectual Property Right (IPR)

A new subject not included in the PMBOK Guide is negotiating and managing the IPR of our products or solution. It may be wise to solicit Legal Experts on this one. You can waver certain components’ IPR, or share ownership with your business partners or collaborators, or full ownership of all components. The objective is to minimize your initial investment and project costs, have the components available for your product or solution sooner, and create a win-win strategy for all parties involve.

Managing Components Integration

As mentioned in “Managing Project Components” section above, the technical Leads should focus on managing components interface instead of component logics. The tradition mentality of creating a specification for coding does not hold value to the development we face today because we have no intention to maintain the components but dispose of the old one and replace by the new one. Since it is single function oriented, therefore, all we need to specify is what the component is supposed to do, what data go in to the components and what should exit the component at the end. Therefore, it is more important for the designer to design and maintain control of component interfaces. For standardization purposes, the individual screen display format become common shared routines. The component structures also eliminate the need for specifying how programs are coded.

Manage a Project like a Program

There are many papers, publications, and researches in recent years on Innovation Systems from various governmental and commercial perspectives. However, apart from the simple Apps we download from the Apps Stores, actually trying to build an IT application to achieve innovation objectives through available information sources (both inside and outside of the company domains) has not been fully explored.

These types of development projects can be considered as part of the operational support system as well as part of the R&D efforts. The first sample project mentioned was
developed to create a new operational process to identify opportunities while the second sample project was developed for new product development purpose.

<table>
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<tr>
<th>IT Era</th>
<th>Information Focus</th>
<th>De-facto Information Owner</th>
<th>Method of Acceptance</th>
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<td>Automation</td>
<td>System</td>
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<td>Through Parallel Run demonstrating equal results of manual and automated processes</td>
</tr>
<tr>
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<td>Expectation Management demonstrating meeting management objectives</td>
</tr>
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<td>Innovation</td>
<td>Client</td>
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Application development for the Innovation Age inclines to invalidate all traditional development methodology available. It all start as a strategic visions that are conceptual in nature and there is no precedence in the IT industry how to manage such development processes in term of Deliverable, Budget, Resources, Risks, Changes, Quality (Acceptance Criteria), Timeline, and Progresses. While project management knowledge still applies to the engagement life cycle, the life cycle itself have to be closely examined so that a development model can be derived for meeting delivery objectives. It may be possible certain innovation model developed by researchers on innovation management can apply.

The convergence of information and technology is going to enable organizations to leap forward in today’s global competition. The Clients we are facing are not researchers, scientists, nor individual who are trained to spot opportunities. The project deliverable will be used by individual ranging from senior executives to operational staff, which needs to deliver various forms, shapes and details based on the clients’ personal perspective and characteristic on their vision of achievement from a pool of ever expanding information sources outside available to the organization.

The sample projects indicated that the best way to manage this type of Innovation System development project is to manage it like a program and continuously measure the opportunity matrix after transfer of system ownership to user for operational purpose. Instead of measuring benefits and capabilities of program outcomes, we measured value and opportunities of pre-defined strategic objective of the project deliverable.

Indeed we are experiencing another paradigm shift of information behavior. The internet technology and amount of information available from internal sources and public domains enabled end-users (clients) to search for and retrieve information by themselves in any forms and ways they choose. The new paradigm shift of information behavior will focus on client perspective and future IT solution will focus on how Clients wish to create the
innovation tools for their specific purpose. It will certainly impact the IT industry in the near future, and the way we manage these solutions.

End of Part II

Next month, we shall explore how we can change our traditional mindset from trying to manage Scope and Requirements that do not exist today, and focus on identification of deliverable definition and creation of the process map that enable us to manage today’s project. An early Wish to you all, a lovely Christmas Season and a Happy New Year!
About the Author

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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