Leading Enormous and Complex Projects or Programs [1]

The standard development methodology fails unique, enormously big and complex projects

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Lessons to learn

1. Extremely large system development projects (the technology part of a business solution that is to facilitate and/or enable a vision or a new paradigm) are **not only complicated but are also complex**.
2. Most organizations do not know how to successfully develop enormously large and consequently complex application systems, but because they think they know, they attempt them and hence, fail them by design.
3. In order to develop enormously large and consequently complex projects, we have to **reduce their size**, use a **unique customized for the project methodology**, and **project governance structure**, that reflects the organization's capability, its capacity, the project and the people involved.
4. **We may not be ready to accept** (beside the need for climate change, or gun control) that the current system development methodology needs significant changes when used to develop extremely large and consequently complex projects.

Abstract

In the last two decades, the size of many system development projects grew and exceeded all upper bounds. These enormous and complex projects (programs) have unmanageably large number of: functions and resulting lines of code; development teams comprised of people with different skills; stakeholders; and different and changing requirements that define the expected outputs. These projects cost hundreds of millions of dollars and take many years to develop and deploy and impact the organization in such a fundamental way that most operational people resist them. They are analogous to the most exciting concept in the universe and so, we will call these totally overwhelming, all consuming, centers of the organization's focus, *Black Hole Projects* (BHP). [7- Villanyi Bokor, 2017]

Developing *BHPs* with a standard development methodology that is focused on producing outputs based on requested requirements, under a governance structure that is slow and mostly administrative, has proven to result in outcomes that are less successful than desired. BHPs take

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significantly longer to develop than planned in the initial estimate of the schedule, cost more than initially estimated and do not deliver the critical success criteria of the vision set at the start. "According to a 2013 Strategy&/Katzenbach Center survey of global senior executives… the success rate of major change initiatives [BHPs] is only 54 percent". [A- Katzenbach, 2014] According to this, only 54% of the BHPs deliver their expected outcome. According to empirical evidence, only the exceptional BHP is successful, often due to luck.

In short, most organizations do not know how to develop BHPs that are built to enable a new paradigm, but as they think they know, they attempt them and hence, fail them by design. The worldwide cost of failing very, very large projects is between $3 and $6.2 trillion per year. This is unconscionable.

The most significant cause of such poor results (we suspect) includes: our tolerance for even smart people, to do stupid things; the (enormously large) size of these projects and the resulting complexity; the long development time scheduled; inadequate pre-development problem and business requirements definition; an output focused requirements management process; and a project management plan that overlooks the organizational capacity (due to the portfolio of projects already underway) and capability (limited by the available skill sets) to undertake such projects. In other words, using a methodology that was not designed for BHPs, in its standard (i.e. not unique to the organization and the project) form, and a project governance structure that does not support the project's needs.

As a project's probability of success varies inversely with its size, we need to limit the non-vital functionality we develop in order to reduce the size, complexity and length of time needed to develop these mega-projects. We must assemble the solution out of smaller projects rather than subdivide the BHP into sub-projects and use a customized, unique and iterative BHP development methodology, project specific governance structure that empowers and responsibilizes Business Analysts and calls to replace the Project Manager with a Project Leader.

INTRODUCTION

Contrary to mounting empirical and statistical evidence, many organizations and inadequately prepared ambitious people think that there are no significant differences between large projects and very, very large system development projects. So, organizations attempt to develop enormous and consequently complex projects, with the same people, in the same way, and under the same standard corporate governance that they use to develop other projects. But complex projects, defined as having the property "… which makes it difficult to understand, foresee and keep under control its overall behaviour, even when given reasonably complete information about the project system." [1- F. Marle, L. Vidal, 2016], cannot be developed the same way as projects that are simply large. The size of a project matters, and when we ignore their size, then not surprisingly, we fail them.

In January 2001, McDonald's conceived a global, real-time digital network called '*Innovate*'. It was going to be the most expensive and extensive information technology (IT) project in the company's history. During its system development lifecycle (SDLC), the scope of the project evolved and eventually it was estimated that the project will cost $1 billion to complete. As McDonald's found out, their expertise in mass-producing cheeseburgers and French fries had little relevance to the world of software engineering, integration and implementation. The project was scrapped after $170 million was spent on it. Similarly, the cost of the Canadian Firearms Registration Project exploded from an original estimate of $2 million to more than $1 billion (and counting). Some Liberal Members of Parliament are alleging [as nobody will actually do anything] ministerial incompetence. Really? After its development, it was reported that: "The government … plans to spend $50 to $60 million every year to operate the registry." "17 percent of large IT projects go so badly that they can threaten the very existence of the company." [2- Calleam, Project Management, 3/7/17]

Unfortunately, the list of examples is long, as only 54% (1- Aguirre, von Post, Alpern, 2013) of the enormously large projects' and major change initiatives' outcomes are considered to be as expected. According to a number of studies, we fail about two thirds of the change efforts. "Big projects fail at an astonishing rate" [4- Matta & Ashkens, 2003] and "No success was found [when project duration was] above 2,400 man-months.". [5- Holgeid & Thompson, 2013] The worldwide cost of failing very, very large projects costs between $3 [4- G.Kim & M Orzew] and $6.2 [6- Sessions, 2011] trillion per year. The number depends on what is included when calculating the cost. In a world that has four billion people living on less than $2 per day this is unconscionable.

I. SOME PROJECTS BECAME ENORMOUS

According to a common belief, a project is a temporary endeavour that has a defined problem to solve, specific deliverables to produce, a start date, a few stakeholders, an end-date, and an allocated budget that is based on the selected solution, the estimated effort needed and the schedule. This idea served its purpose in the '70s and '80s when application system specifications were written 'over coffee' on a napkin, when application systems were coded in COBOL or FORTRAN, were designed to automate specific operational procedures, and were developed and ran on mainframe computers.

It needs to be changed, however, when the application system development project is very large, costs many millions of dollars, uses many people with different skill sets and takes years to develop, implement and deploy. The primary focus of such a project, is not efficiency but to enable the organization to reach its strategic objectives and/or to enable better customer service and experience or enable a new business model. Some of these very large projects evolve into larger than very large projects. These larger than very large projects have to be developed using a formal project management methodology, take longer than the established schedule and/or end up costing much more than the originally estimated and allocated budget. When they are

deployed, they do not meet all the usual or all the initially defined success criteria and they make the measuring of their success as challenging as their development. We will refer to these projects as *Super Sized Projects* (SSP).

In the last two decades the size of some SSPs exceeded all upper bounds. These projects have very large number of stakeholders, many different, unstable and evolving stakeholder requirements, are scheduled to last many years, have to be developed in a modified / customized development environment, using a customized project management methodology, and an adaptive and evolving systems design and development lifecycle (SD^2LC), use unmanageably large development teams and a formal governance structure that often becomes purely administrative. As efficiency is not their primary aim, these innovative, disruptive, enormous and evolving projects are conceived to enable the organization to reach one or more of its strategic objectives, and impact the organization in such fundamental way(s) that most operational people reject them, even if they do not admit to their views. These totally overwhelming, all consuming, centers of the organization's focus are analogous to the most exciting concept in the universe and so we will call them *Black Hole Projects* (BHP).

A BHP is developed to make a business impact, change a vision or introduce a new paradigm. It is sponsored by a senior executive with a 'line of business' (LoB) sponsor, aligns to an organizational strategy and is part of an organizational solution that is to achieve an expected and desired outcome, i.e. that needs to follow as a result or a consequence of deploying the solution. This solution remodels all service components and consists of an enabling technology component, a business process transformation component, a people component and if needed, new policies. It is no wonder that the development of such a project seeks out or needs a new development methodology and a new governance structure.

Developing BHPs successfully, using standard project management methodologies and corporate governance, has generally proven to be beyond the capability of most organizations and beyond the capacity of some others, as: *"Big projects fail at an astonishing rate."* [4- Matta, Ashkenas, 2003] They last significantly beyond their initially established, too long to start with development schedules, end up costing several times more than their poorly estimated and allocated initial budgets, the solution and its design is constantly evolving as stakeholders keep asking for changes to their far too numerous requirements. [7- Villanyi Bokor, 2017] So, executives to 'save face', change their scope and deliver reasonable, at best, satisficing outputs.

In short, we do not know how to develop them. "The failure rate of projects with budgets over $1M is 50 percent higher than the failure rate of projects with budgets below $350,000." [8- Gartner, 3/7/17] These projects are not viable when we use our current development approach, and hence, we generally fail them by design. "… members of the Senior Executive Service, the elite ranks of federal managers, 60 percent said that government was less capable of executing large projects today than it was thirty years ago." [9- OAG, 2011] Unfortunately, there are

numerous examples and statistics to back this up. Only the exceptional BHP is successful, often due to luck.

II THE PROBLEM WITH BHPs

"A study of 163 companies found that 37% of IT projects were at risk." [10- CIO Analysis, 2011] Many BHPs are failed by its stakeholders, the Project Manager (PM) or its Project Leader (PL), Business Analysts (BA), the project governance framework or oversight committee, and/or the methodology. To a large degree, this is due to a number of significant problems that hamper the leadership and the development teams when developing a BHP. "… the problems involved are management related, more specifically, change management." [11- Shared Services Canada, 2016] While it is neither necessary nor sufficient to commit any of the following errors in order to fail a BHP, a significant portion of BHPs are failed because the following have not been dealt with effectively. Others are failed because people are ingenious and constantly invent all sorts of unchartered new ways.

2.1 The tolerance for stupidity

The very large number of people used to develop a BHP, the redundancy in the work that they do, the complicated informal relationships that exist between them, the groups or teams into which they are allotted, and their preoccupation to do what is best for themselves, promotes people, even smart people, to do stupid things. This is not criticizing the people themselves. This is not about pointing to people and asking yourself: "Who gets them dressed in the morning?" "In most cases, differences in individual capability simply do not help us differentiate success from failure when it comes to complex, high-stakes decisions." [12- Roberto, 2009] This is about thinking and making decisions. As an example, according to a 2014 SAAQ survey [13- MONTREAL enSANTE, 2016] 99% of Quebecers agreed that writing or reading an electronic text message while driving is dangerous, as it increases the risk of having an accident by 2,300% [same source]. Yet 56% of these people admitted to reading a text and 22% responded that they write a text on their 'smart phones' while driving, i.e. they do this stupid thing. Society's tolerance for stupidity includes the continued selling of cancer causing cigarettes, making people wait in the hospitals' emergency units, allowing driving and parking on downtown city streets, allowing cruise ships to poison our oceans while pork and beef production poisons our land, making air pollution "… responsible for 6.1 million deaths and accounted for nearly 12 percent of the global death toll in 2016, [14- Schumaker, 2018] and the list goes on. Society's mores also extend to systems projects, as: "Similarly, common sense is often ignored in systems projects." [15- Dorsey, 2005] As an example, a PL selected to lead a hundreds of millions of dollars BHP was authorized to concurrently undertake an executive MBA, and as expected overspend the budget by hundreds of millions of dollars. Organizational leaders not only make stupid decisions but also tolerate stupidity.

In July 2017, the Canadian federal government decided to substantially curtail the multimillion-dollar Canada.ca project, acknowledging that its plan to merge 1,500 departmental and agency websites into a single website is sputtering. Mr. Scott Brison, president of the Treasury Board, has said valuable lessons have been learned [without stipulating the cost of these lessons] from recent failures of large government information technology (IT) projects. (Adrian Wyld/Canadian Press). "… the project is more than 10 times over budget and more than a year behind schedule, making it yet another failing government IT project, not unlike the Phoenix pay system…", [16- Karina Roman, 2017] from which nothing has been learned.

2.2 The problem of size and complexity

Enormous projects, that is BHPs, are neither designed nor developed to solve an operational problem, to automate or to increase efficiency, as in automating the sending out of invoices. They are conceived to support a new paradigm or a vision, such as eliminate the need for invoices. Consequently, they force significant changes on the organization and its people, introduce changes to cultural norms, operational paradigms, and enable innovative and/or disruptive solutions that allow the organization to work like it was never able to work before. Due to the unmanageably large number of function points, they are comprised of an enormous number of lines of code (LOC), so, developing and deploying them takes a long time. As a related argument, many are scheduled to take longer than they should, which is a separate but related problem. Executives and development leaders ignore that: "… the longer a project is scheduled to last, the more likely it is that it will run over time and budget." [17- Bloch, Blumberg & Laartz, 2012] Evidence also suggests, contrary to common sense, that scheduling a project to take too long (surpassing two years), i.e. increasing the development cycle, also increases the number of 'bugs' it will have, which extends the testing period. So, as should be expected, the long development schedule initially agreed on gets even longer.

The differentiating and the most significant problem with BHPs is that the numbers that quantitatively distinguish them are overwhelmingly large [7- Villanyi Bokor, 2017]. BHPs involve a larger than manageable number of people who have to follow many administrative procedures, have a very large number of stakeholders, and many interrelated components. As overlooked possibilities to improve the solution are discovered during system development, and as the organization's requirements become clearer, the business and/or technology part of the solution must change or evolve, which generally increases the size of the BHP and paradoxically diminishes its initially anticipated success.

What is not usually heeded, is that while a six-person six-month project has a 55% chance of success (15- The Standish Group, 2013) a 250-person project that takes 24 months only has an 8% chance to succeed and a 0% chance that the risk of failure will be acknowledged, the risks will be managed or reported by the designated PM. As presented in another finding, "While projects less than 24 man-months have a 25% probability of underperforming, … No success

was found above 2,400 man-months." [5- Holgeid & Thompson, 2013] It is the exceptional organization, oversight committee, manager, project leader, methodology or quality assurance (QA) process that critically reviews a project's size and complexity. Even fewer will attempt to limit its size, although as Saur, Gemino and Reich reveal, the risk of a project failing increases with project size. [18- Saur, Gemino & Reich, 2007] "… large projects have a tendency not delivering the promised value…" [5- Holgeid & Thompson, 2013] "… suggests that half of all IT projects - …massively blow their budgets. On average … run 45% percent over budget … while delivering 56 percent less value." [17- Bloch, Blumberg & Laartz, 2012] In other words, BHPs have to be expected to cost three times what they were estimated to cost (if 44% of the deliverables costs 145% of the budget, then 88% of the deliverables costs 290% of the estimated budget).

Further, the BHP's size causes the number of people, as well as the size of the teams working on the project to be orders of magnitude larger than the number of people that managers and executives know how to manage [19- Royce, 1970] and align effectively, so teams do not work cohesively. Senior leaders do not talk about what needs to be done, do not debate new ideas, do not respect one another's perspectives then work collectively toward a common goal. When there are many senior leaders, they do not work very well together as a team. This is a problem as team-based professional work may only have been about 20 percent in 1990s, is about 80 percent [*Briefings magazine*] today. As Robin Dunbar found, we are (our social channel capacity) comfortable in a group that is less than 150 people. What is worse is that on a BHP, the number of people and the number of administrative managers grows as the length of the project grows, making the team progressively harder to manage. This, further increases resource costs, management, oversight costs and inefficiency.

The enormous size of BHPs makes them complicated, like a jet liner, and their many interconnected and interdependent parts, that collaborate to make a functioning whole, and are developed by many semi-independent teams, makes the project difficult to model, and internally complex. BHPs are analogous to a pancake mix that does not readily reveal its components of oil, egg, milk and whose exact outcome is only a guess.

2.3 The inadequately defined solution

> "If I had an hour to solve a problem I'd spend 55 minutes thinking about the problem and 5 minutes thinking about solutions." Albert Einstein. [20- goodreads.com/quotes]

While a project is developed to help solve a business problem [21- Villanyi Bokor], a BHP is developed to facilitate or enable the actual state of the business' affairs become the desired state of affairs. So, while many projects, unfortunately, are developed to deliver a number of outputs, a BHP is undertaken to facilitate or enable a business solution, i.e. processes, people, technology

and policy for one or more organizational programs or branches to deliver an outcome that supports the organization's goals or strategy.

When the project is a BHP, the system design that is prompted by the requirements of the solution, vision or outcome (note, not the problem), is only a "good idea". Generally it satisfies not optimizes how to reach the outcome. "the interactions among the tasks, subprojects, and governance structures of a complex project make it all but impossible to fully define the project deliverables or grasp the resource requirements ahead of time." [22- Shapiro, Lorenz, 2016] The *Standard for Project Complexity and Risk* states that project complexity is based on the number of business rules, the technology employed and the size of the project. It further indicates that complexity is a major component of project risk and that complexity should be determined at the start of all large projects, and when changes occur. Software Engineering Institute (SEI) talks about complexity, as a design or implementation that is difficult to understand and verify, and that is determined by the number and intricacy of interfaces and conditional branches. This makes it difficult for the Business Requirements Document (BRD), to be a clear and comprehensive elaboration of the business requirements. According to SEI, the BRDs are limited by the programs' or project champion's imagination and design experience, by stakeholders who do not know and /or state all the business requirements at the Requirements Gathering and Definition phase, and by the BAs' capability and/or dedication to list and to elaborate (well or otherwise) all the important requirements of the business, as well as the user(s')'s unrequested needs.

So, as the initial solution is only a "good idea" that is imprecisely known, it necessarily leads to business requirements that are also imprecise. This is one part of the problem, because: "The lack of clear requirements at the outset of a new IT project …. is the number one killer of initiatives within large organizations". [6- Sessions, 2011] The other part of the problem is that the stakeholders' requirements, which are often their requests rather than the business requirements, are often thought of as being comprehensive, exact and detailed. Hence, a system that is designed on them, is also considered to be what is needed. But because the gathered requirements are in fact imprecise and are missing details, they will consequently not enable the expected outcome to be reached. They will have to change, and we should expect them to. "Inaccurate requirements gathering remained a primary cause of project failure (37%) in 2014." according to PMI Pulse of the Profession Study. [23- EXECUTIVE BRIEFING SERIES, 2015] Expressed another way:

NEW PARADIGM or VISION ⇨ BUSINESS SOLUTION ⇨ SYSTEM REQUIREMENTS + BUSINESS TRANSFORMATION ⇨ REQUIRED SYSTEM OUTPUT + PROCESS CHANGES

2.4 The problem with project governance

It may be unpopular and a significant danger to one's career to state it, but the project's outcome, whether a huge success or a classic disaster, is mostly a result of the effectiveness of the project governance. This is a shared result as many play a role in the success or in successfully failing a project. As a start, the selection of a Project Leader (PL) rather than a Project Manager is a critical success factor (CSF). Not that calling the lead a PL solves the problem. PLs need to lead, meaning that they must assume the needed authority whether it was given to them or not. Key stakeholders need to demand the use of Customer Centric Project Management (CCPM) and demand from the PL a project management plan (PMP) and a master schedule, weather senior management has created their own wish list or not. If these two are not defined with the appropriate care and conviction, accepting to go on is a design for failing the BHP.

PLs need to expect changes to the project's scope, identify poor performers and rising stars, reject that anyone can learn anything in a short two-day training session, that clients are only needed to define the Detailed Business Requirements (DBR) and to conduct User Acceptance Testing (UAT), and that bad news will go away if not reported. They must solicit client feedback on how the project is being managed, validate believed expectations and not 'beat themselves up' when a mistake is made. Mistakes will be made. How the PL deals with a mistake is more important than the mistake.

Generally, governance misuses the PL's time and makes the PL, seem to be, as well as be, less effective than possible and necessary. "..between 80% and 95% of project failures are a result of either human or miscommunication…" [24- Pellerin, 2009, pg. 11], which is another confirmation that projects do not fail, people fail them. "… a balanced governance structure … is a critical factor in the success of a large IT project." [11- Shared Services Canada, 2016] If a BHP is to attain most of the original business goals, an unexpected achievement, it will have to have an active and engaged executive champion or sponsor as well as a Project Leader.

The role of the PL is further complicated by the different personal goals (WIIFM) and agendas of the PMs of the sub-projects that BHPs are generally divided into. These PMs manage the experts in their development teams to deliver the requested and documented results, or outputs, using a standard (in the organization) development methodology, because that is how they will be measured and considered successful. Most PMs working under the constraining oversight of several governance and review committees are not authorized to change the project's plan so they execute with a focus on delivering on-time, within budget and the functionality that is specified. Many cannot, even if they wanted to: "…determine and select opportunities for improvement and implement necessary actions to meet customer requirements and enhance customer satisfaction…" as is required by ISO 9001.2015. So effective PLs have to act on their instincts and spend a significant amount of their time communicating and inspecting what they

expect from others. The first 90% of development is the easy part of delivery and when things get behind schedule, 'catching up' is as desirable as it is unrealistic.

Therefore, a complex project's governance structure must define how decisions will be made, how the staff, supporting contractors and consultants will be managed and/or lead, and whether their work schedules will allow them 'flex' time or will they have to be on-site 9:00 a.m. to 5:00 p.m. If senior team members will be treated as managed staff, then very often they will deliver as such, or leave. While putting a consultant hired to write strategy in a hallway, in heavy traffic is an efficient use of office space, it is not an effective use of the consultant. Nor is forcing PMs to use detailed templates, essentially telling them '*how*' to do their jobs, not only '*what*' to do. All decisions have consequences, and an inappropriate project governance structure will prove its dire consequences. "Organizations that are ineffective with project management, waste 21 times more money than those with the highest performing project management capability." [25-Andres, 2017] According to a study by Metagroup ('*Why Operation Projects Fail*?' November 2002) 70% of large IT projects fail or do not meet the expectations.

2.5 The problem of inadequate capacity and capability

Validating the capacity and the capability of the organization in which the solution will be developed and/or deployed, and/or that of the development environment, is a reality check and necessity that is often overlooked. Few PLs schedule time to this activity. Generally, it is assumed that the organization can do anything others are known to have done. No senior executive will admit to having a second-rate unit. As such the capacity and the capability of the organization is taken for granted. It is rarely known whether the organization has or does not have the capacity and the capability to undertake the BHP and seldom known if the resources (PM, BAs, Project Champion DG) assigned to the project have the required capability as well. Hence, projects and tasks that may have to be done and may have to be done for a certain time, are scheduled, without taking into consideration all the pertinent factors that play a role and may render the environment and / or the assigned resources inhospitable to the task. This is feeding a vicious cycle that deteriorates credibility and reinforces the culture that accepts deliverables to be late. As an example, one $150 million government program was thought to need no more than a part time PM. Most organizations and PMs can deliver the first two-thirds of a project. The last 20% however, gets tricky.

2.6 The problem of methodology

An interesting question to ask people is: "Do you have a standard shoe?" Some will rush to say that they do. But, they may change their minds were they to be asked if they can use such a standard shoe to go to work in, go out to a party in, go running in, wear in the snow and when playing basketball or bowling. As different shoes are designed for different environments, conditions and different types of activities, a compromise shoe will not work well in all

conditions or optimally, and sometimes may not work at all. Similarly, standard development methodologies do not work well when delivering a BHP, when they do not take into consideration the size of the project, the development environment, the organizational culture, the size of the teams, the number of teams, the prevailing project governance structure and the capability of the people involved.

2.7 Other reasons

While there are other reasons why we fail enormously large projects that are not dealt with here, these are generally secondary, even if they can flare up in some projects. Some to mention a few, include:

- The project schedule. While going to the grocery store can be accomplished without one, an enormous project, certainly a BHP has no chance of success without a project plan and schedule that includes all project activities' and tasks' interdependence. Further, not only must a BHP have a project plan and schedule, but they must also must be used.
- No Quality Assurance (QA) tasks are scheduled or conducted.
- On many projects, Risk Management consists of documenting the risks that stakeholders consider and talking about them, a.k.a. tracking them in monthly meetings. The need to appoint someone to be responsible for managing the tasks that mitigate, transfer or eliminate the existing risks is not considered important and/or is not done. It has been demonstrated that failure to deal with risk is a main cause of the budget being exceeded, falling behind schedule, and/or missing performance targets (Carbone and Tippet 2004). Poor risk and issue management. "Quite frankly, how you handle the risk or issue is more important than the issue/risk itself." [26- Alie, 2015]
- The phase for detailed requirements definition, takes much too much time, and ends up with too many requirements, not all of which are required by the business. This leads to the development of Agile and Customer Centric Requirements Management. The role and the responsibilities of the BAs need to be defined and Change Management needs to be focused on the needs of the organization and the outcome it expects to achieve.
- The decision to make or not to make an identified change to one or more requirements does not use the findings of a continuous benefit realization analysis. This means that benefit realization if done, is scheduled after the developed system is deployed.
- 'Soft' reasons include: weak project estimates, failure to set and manage customer expectations, reach common understanding of requirements and/or the solution, establish a baseline, failure of key subcontractor to deliver.

III. TO BUILD A NEW DEVELOPMENT FRAMEWORK

Based on the reviewed empirical evidence, BHPs exist and have the previously elicited vital problems or main differentiators. Therefore, they have to be developed using a different development methodology and governance structure than what is used to develop other projects. The following offers a 'step' towards defining a preliminary framework or methodology skeleton, which can be customized for each BHP. This customization is to be based on the specifics of the project, the development environment in which it will be developed, the organizational culture in which it will be deployed, the project governance structure that will define roles, accountabilities, team building and the decision-making process, and the organization's, executives' as well as the project team's capacity and capability. The following proposes that we make vital changes to how we think about developing BHPs.

As an analogy, leading a BHP development is similar to competing in a Formula 1 race. In order to be competitive in Formula 1 racing, the Formula 1 entry must have a F1 driver who is capable of driving a F1 car competitively, not simply a driver or a good driver. Similarly, in order to develop a BHP successfully, the project has to have a PL not just a PM.

In addition, as a Formula 1 entry also needs a F1 Team that can support the car and as an example, decide when to change tires, monitor fuel consumption, and decide on the right air pressure for the tires, the BHP needs a project dependent governance structure that makes the decisions the PL cannot make and that supports the decisions that the PL does make. Finally, as the entry needs to have a quick ratio steering wheel, paddle gear shifter, a double clutch, and the right tires, a BHP needs a customized methodology, be in an environment that has the capacity and the capability needed for the project and tools to remove the roadblocks set up from the following.

3.1 Avoid the Stupidity

Many people reading the above heading will first think that a more politically correct language or expression would have been preferable and that the word 'stupidity', meaning behavior that shows a lack of good judgment, should be replaced with *absence of intelligence* or *suspended thinking*, or even *honest mistake*. However, the word was retained on purpose. Using a more politically correct description would understate the importance to avoid these types of mistakes, the enormity of the problems they create and almost condone making very, very bad decisions that have grave implications, and/or not doing what should have been done.

"Only two things are infinite, the universe and human stupidity, and I'm not sure about the former." Albert Einstein

First and foremost, avoiding stupidity is not equivalent to calling people stupid, as even smart people do stupid things. As one example of showing a lack of good judgment or making stupid decisions, in the days when smoking was permitted on airplanes, is having a smoking section. Really? It was like having a peeing section in a swimming pool. As another example, the US Challenger disaster was an avoidable stupid mistake. Engineers knew, reported and debated that the 'O rings' are not acceptable for the environmental situation into which they were placed, so the possibility of the outcome was anticipated. As a final and a more recent example, in 2015, 34 children were killed as a result of their parents or guardians leaving them in a car that in a hot climate not only warmed up but also became deadly. In 2016, three times as many children were killed by this act of unacceptable neglect that is not an *honest mistake* but a stupidity.

Many errors on a BHP are acts of stupidity. Examples include authorizing major projects that are scheduled to take four or five years, which is too long; assigning an experienced PM, to do 'one more time' what he mastered in another development environment or organizational culture; Dummy-ing down expertise, as when an expert has to justify the approach/innovation to an overseeing person or oversight committee that does not have the same high level of expertise and understanding; and assigning a PM, or assigning a PL who is preparing to and very excited to get married during the project development SDLC, to lead the BHP. Other examples include assigning a PL who is enrolled in an MBA program to develop a BHP concurrently, hence part time; not having a full time expert risk manager and/or benefit realization manager; and attempting again to develop a portfolio of some 30 separate projects, after having failed two previous times before. These are stupid decisions that disregard the foreseeable catastrophe, and lead to significant repair bills. One such example is the repair of the Canadian Phoenix Pay system, that has risen to over $402M, which is more than the $309.5M its development cost. [27- CBC News, May 24, 2017] Not making allowance for changes and adhering to preconceived notions, i.e. doing it 'the way we do things here' regardless of evidence to the contrary (confirming bias) is today's destructive stupidity. Why is it that we even consider an argument such as: "I have not been able to respond to you in the last 3 months, because I do not have the resources to undertake the analysis to determine if we can or cannot do what you asked for. So, I cannot tell you if we can do it or not.", as some sort of valid but inconclusive response. Why is it that we cannot register this as a response saying 'I cannot do it'?

3.2 Manage Size and Complexity

If the successful implementation of a project varies inversely with its size [20- Carroll, 2006], then we should heed empirical research, and the Standish Group's [28- The Standish Group International, 2013] categorically stated conviction and recommendation, and enforce limits on the size of the projects that we undertake.

3.2.1 Limit the Size

We fail most of the overwhelming and enormous large IT development projects or BHPs. In fact, the bigger the project, the more likely it is that we will fail it. [6- Sessions, 2011] This is important to acknowledge. Their size (as well as the ever-changing requirements) makes them a technically complex project which is the second most important finding regarding why we fail projects. [17- Bloch, Blumberg, Laartz, 2012]

3.2.1.1 Allow the solution to evolve

No matter how well the business analysis phase intended to elaborate the best business solution (i.e. the bridge to the vision), which includes and defines the BHP, according to 78% of stakeholders in some studies, the detailed business requirements (DBR) on which the system development outputs are based, are out of sync with the business. [29- Geneca] In part, this is because requirements are not what they should be. There are a number of reasons for this. The first one being that the stated requirements are sometimes based on a solution for which not all the necessary details are known, and which will only be clarified as development proceeds. Another reason is that sometimes, stakeholders just glance over the documented requirements and approve them without reading in full detail, the long winded, technically detailed and exhaustive narrative. This of course, will lead to a system design that will need to be corrected and reapproved and will impact the project, the budget as well as the schedule.

While neither the previous nor the following is a problem, requirements may be in whole or in part, requests, not business requirements. Worst case, they are common sense needs that stakeholders present to the BAs after having spent, what they consider to be too much time elaborating their expected business outcomes.

As a consequence of the above, the originally requested output will have to change, or will need to be added to. "The chances that these requirements [identified up-front for a >$100 million system] will accurately reflect all of the needs of a large complex system are poor." [6- Sessions, 2011, pg. 6] While contrary to what '*everybody knows'*, less business analysis time needs to be spent to define pre-development DBRs, i.e. high-level business requirements (HLBR) which are to be the initial set of requirements, while more business analysis time needs to be spent on continually defining the vital, the needed and the requested components of the evolving solution, and on how these requirements, stated or not, interact to deliver the expected outcome. "There is a 60% time and cost premium to be paid on projects with poor quality requirements." [30- Keith Ellis,]

3.2.1.2 Reduce functionality

Fewer LOCs means savings in the development and testing effort, and an even greater savings in the cost of on-going maintenance of the code. To reduce the number of LOC that need to be written, we have to reduce the number of functions that are needed to be delivered. This means that fewer errors will be made and corrected in testing, and a smaller development team will be needed, making it easier to lead the project. The need to enforce limits on the size of a project and to reduce its accompanying complexity is not only supported by The Standish Group International, [28- The Standish Group International, 2013] but also by those who believe that only 20% of a BHP's functionality is vital for the project or solution to deliver its intended outcome and that only 50% of the users' initial and evolved requests/requirements (leading to delivered output) will produce system functionality that will be used. This 'school of thought', that generally, 50% of the systems' delivered functionality is never or hardly ever used, and that if they are used they are used by only a very few people, implies that reducing the requested functionality is possible. But, this is not the role of either IT or the PL. A very oft-cited metric is that 64 percent of features in products are "rarely or never used." The source for this claim was Jim Johnson, chairman of the Standish Group, who presented it in a keynote at the XP 2002 conference in Sardinia.

Looking at this from another angle, having a huge number of functions is, in part, 'dummy-ing down' and preventing the system's users from having to and/or being able to think and make decisions. It is automating. Having fewer functions encourages and/or forces system users to think and to be involved with how the business results are delivered. Having very many requirements, requires less BA or system design expertise. As Woodrow Wilson has said: "*If I am to speak ten minutes, I need a week for preparation; if fifteen minutes, three days; if half an hour, two days; if an hour, I am ready now.*"

3.2.2 Limit complexity

BHPs are extremely hard to develop successfully. Based on the achieved results of past attempts, and as expected, they are almost impossible to develop as originally planned. There are many reasons for this finding, one of them is that the interactions of numerous variables makes BHPs complex. "For every complex problem, there is an answer that is clear, simple, [intuitive] and wrong." [31- Mencken]

Robert Glass' supposition in his book *Fact's and Fallacy's about Software Engineering* "…says that every 25% increase in functionality results in a doubling of complexity." [6- Sessions, 2011, pg. 9] and because we have problems developing complex projects, we must limit their complexity by limiting their functionality.

3.2.2.1 Don't subdivide, assemble

One way to reduce the functional complexity of a BHP is to divide it into a number of smaller sub-projects. Each of these sub-projects will have a fewer number of function points, simpler deliverables, a clearer objective, and therefore a simpler less complex design. "*The secret of getting ahead is getting started. The secret of getting started is breaking your complex, overwhelming tasks into small manageable tasks then starting on the first one."* Mark Twain, [20- www.goodreads.com]. Reducing the functional complexity of a BHP is desirable and may even be necessary if the BHP is beyond the capability and/or capacity of the organization. However, dividing a BHP increases its number of sub-project PMs, sub-project development teams, and worst of all, the number of human and application program (sub-project) interfaces (API) that allow inter sub-project communication. This increase raises the BHP's interface complexity, called 'coordination complexity' by R. Sessions who expertly calculates it in his paper, [6- Sessions, 2011] and shows it to grow incredibly large if the BHP is broken into many sub-projects which it undoubtedly has to be.

An alternate way to 'break up' the project is to turn the process around. Instead of subdividing the BHP into sub-projects, the BHP is assembled out of smaller discrete projects. Each of these is to deliver one or more vital functions needed for the visionary solution and have clearly defined interfaces. Based on this approach and by reducing the functionality of the BHP, the number of projects (the old sub-projects) will be much smaller, in part because only about 20% of the required functions are vital functions of the solution and will be better defined. Added to this will be the additional projects that will deliver the remaining needed functions, so that all together in general about half of the original BHP's otherwise defined number of functions will be needed, thus reducing many of the quantifiable variables (e.g. number of LOC, number of team members, number of APIs, number of development months). Surprisingly, based on empirical evidence, assembling the BHP out of these simpler, more focused, easily integrated vital and needed outcome enabling projects, will take only a third to one half the otherwise required time to develop and deploy.

As the BHP thus assembled will require fewer team members, and the number of members on each project team will be (if possible) limited to around seven, the PL will have the time to focus on relationships, reduce the size of the project's administration (executive team members who coordinate, advise, facilitate, oversee but do not develop), and align all smaller projects to an expected outcome they are designed to support. By reducing the BHP's excessively large team that otherwise keeps growing, the number of people doing redundant, overlapping work and the time needed to appease the workforce is also reduced. This will increase the productivity of the developers and will also lead them to be more satisfied with their jobs.

3.3 Define the Problem

Having the business problem (P) that needs to be solved well defined, is a *sine qua non* when developing projects. Organizations need to spend the time to define the problem that they are trying to solve, as well as its root causes, as Einstein seems to have thought. The business requirements to solve the problem are based on the problem and in turn determine the application system. The outputs (O) developed are the deliverables of the technology component of the chosen business solution (S), and what will facilitate the organization to achieve its expected business outcome (BO). In symbols, this is:

P ⇨ Business Req'ts ⇨ S ⇨ System Req'ts ⇨ O ⇨ BO

However, BHPs are conceived to usher in a new vision (V) or a solution that will help achieve a new desired BO. As an example, a BHP is not developed to produce a report because the number of coffees sold is not known, but to track the number of coffees sold in numerous outlets, worldwide and in real time. In system terms, the vision to have all guns registered and accessible to all law enforcement officers leads to an on-line application system solution that will provide all law enforcement officers on-line, real time, immediate access to all guns and their owners. Hence, the operational paradigm or selected solution that will facilitate and/or enable the corporation to achieve the desirable success is the basis of the expected BO. It is this, rather than a problem, that will define what the business requires and the '*raison d'être*' of a BHP. This in turn is what the system requirements and the process changes are built on, and that define the needed system outputs (O). Not being able to work in this new conceived way is then made into the problem. In symbols this is:

V ≡ S ⇨ BO ⇨ Business Req'ts ⇨BHP ⇨ (System Req'ts + Processes) ⇨ O

This is one of the indicators, maybe the first indicator that BHPs are about facilitating and/or enabling business processes and people to reach expected outcomes. It is, like all other projects should be, focused on delivering the outputs that are to deliver the outcome not the outputs that are defined by the DBRs. Unfortunately, delivering outcomes is greatly dependent on having a PL who is focused on these, rather than a PM who is focused on outputs and on allocating the appropriate accountability to the Project Champion. Some still think that success is delivering on-time and on-budget the full requested functionality. Others, that: *"For the past 40 years, for example, we've tortured ourselves over our inability to finish a software project on time and on budget. But this never should have been the supreme goal. The more important goal is transformation, creating software that changes the world or that transforms a company or how it does business… Software development is and always will be somewhat experimental."* [32-DeMarco, 1995].

3.4 Make the Requested Changes

Surveys that were focused on over 100 large companies' projects that were about $3 million each, found that "The data shows that many of these entrenched beliefs about requirements are wrong and doom 68% of companies to project failure before the project ever really gets rolling." [30- Ellis,] The report goes on to say: "Sub-optimal requirements, consume approximately 41.5% of the IT development budget ..." To improve the quality of their DBRs, BHPs, as all projects, use a Requirements Change Management (RCM), a.k.a. change request process during the development phase. Although RCM is designed to control the number, order and the extent of the requested changes and hence the changes to the scope of the project, most often RCM when governed by the technocrats is driven by a desire to limit changes to the system design, the established budget and the estimated schedule. This is totally legitimate in some cases. However, when dealing with BHPs, minimizing the number of changes that are accepted to be made to the system's functionality, impacts making improvements that are needed to the outputs that are to facilitate and/or enable the expected outcomes. This reduces the benefit that will be achievable with the final design.

When developing a BHP, project governance must acknowledge that the list of requirements, sometimes referred to as the DBRs, defined prior to development, is an incomplete and/or inaccurate list, and will need to be changed. Many BHPs that start as a vision or a concept (e.g. go to the moon) are defined and designed, without all the specific details (e.g. navigation computer software) having been first worked out. So, customers need to be able to make changes to the DBRs and their defined / required functionality, when realizing that something was forgotten or that a newly identified requirement would improve the project's usefulness in delivering the expected business outcome. This is why a BHP needs a Customer Centered Requirements Management (CCRM) [33- Villanyi Bokor, 2015] or similar RCM process.

CCRM is an Agile-like method intended to 'put the customer first' and facilitate their requests to change requirements. It is ongoing stakeholder engagement and involvement with *what* the business outcome of the outputs will be in the hands of those creating corporate business value. It respects stakeholders' and system owners' wishes (who are treated as Product Owners, see Scrum) to make changes or additions to vital requirements, and spend the necessary additional resources, while holding them accountable for the impacts that their decisions have and limiting the size of the changes. In fact, as Christopher Lindquist states in "*Fixing the Requirements Mess*", CIO Magazine, "As many as 71% of [embedded] software projects that fail do so because of poor requirements management, making it the single biggest reason for project failure." How can companies not agree to this? [34- M. Boucher, 2016] CCRM aims as per ISO 9001.2015, to: "*…implement necessary actions to meet customer requirements …",* i.e. to make all vital changes so that the delivered solution may enable the defined business outcome, reduce waste and lost revenue. CCPM makes the project sponsor accountable for the benefits realization role, for integrating operational changes needed to identify, track, realize and harvest all expected project outcomes and benefits.

3.5 Define the Project Governance

A governance structure is an explicit declaration of who has authority, who can provide input that has to be considered when making decisions, who is accountable and who makes decisions. The governance of very, very large projects, due in no small part to their size, their size related number of people who work on them, and the relationships that exist between stakeholders, has to be less about managing how the project is developed, although that too remains important, and more about exemplifying how everyone will work together, removing obstacles and looking towards a common goal. This is not to say that executive overseeing committees are not to be concerned about how their investment is spent or is going to be spent, but to point out that the PL must be able to defend project objectives that are set by the project sponsor and the steering committee and the development team leaders must be able to make decisions in the areas that they are experts in. A BHP not only needs a decisive leader, a PL, and subject matter experts, but also needs a timely decision-making process. As an example, a PM reporting to an Organizational PMO that reports to a Project Oversight Committee that reports to a Financial Management Steering Committee that reports to an Organizational Business Investment Committee that reports to the CEO, is just a glorified clerk.

A BHP's governance must be pro-active, define and enforce the single point of accountability, define roles and relationships, manage and resolve issues and deploy the information dissemination strategy. A clear project governance structure and processes identify the responsibilities of decision-makers, the escalation paths for critical issues and rising risks, how changes to the defined work will be requested and approved and who is accountable for what. It 'pushes' decision making 'down the line' (organization chart) to the experts, making its deployment difficult in some organizations. Few large projects' governance or requirements Change Control Board focuses on the business outcome. Too much of the governance even if well-intended ends up being administrative and focused on the project's output and schedule which is not the same as facilitating or enabling lines of business (LoB) attain a different outcome. This adds another 'nail' to these projects' coffins.

Examples of the results attained by weak project governance includes the *Scheduling Replacement Project* between June 2006 and May 2008. The lack of effective oversight by the U.S. Department of Veterans Affairs resulted in the software having over 350 defects, that delayed its deployment by nine months. [35- Veterans Affairs pg. 20] A review of the Veterans Affairs scheduling system project found that an estimated $127M over nine years was expended without delivering any of the planned capabilities. [35- Veterans Affairs pgs. 03-06] Even weaker was the case in Canada, where the government, in a similar situation, did not delay the system deployment of an unacceptably troubled development, impacting 250,000 civil servants' pay for years. Bad governance leads to a focus on cost management, meeting deadlines and basing decisions on promised personal rewards. With inadequate focus on the expected outcome, such a project governance structure is key for failing on all accounts. As a final

example, in Western Australia, it took a total of $401 million and seven years before a program, that indicated that no net benefits will be achieved, was decommissioned. [36- pg. 65]

One requirement for good project governance is for executives to be incentivised to, and accept not to manage or second guess the development PL or its developers. As executives' expertise is (usually) not in developing or implementing systems, nor in how the LoB need to achieve the expected outcomes, their focus must stay on facilitating the projects' development, oversee how the resources are being spent, that the project is within the organization's capability and capacity and that its goal supports the strategy as expected. This is expressed by the *7 Project Keys* Reporting methodology from IBM, which calls on project focus to be on the stakeholders, attained benefits, the schedule, the teams, project scope, Continuous Risk Management (see Software Engineering Institute), and Benefit Realization. Above all, executives' focus must assure those accountable that they will be held accountable. So, oversight committees of BHPs are not set up to review reports from the project but to eliminate the impediments, 'road blocks' that are in the way of the project. Theodore Roosevelt said: "The best executive ... picks good men to do what he wants done, and … keeps from meddling with them while they do it." This requires two other results from the project governance structure. The first, for executives to acknowledge that the project needs a PL whose roles include strategic vision, innovation, team integration, and stakeholder engagement, not merely a PM whose traditional management roles are to plan, execute and control. "*Large and complex projects are more challenging for traditional project managers because they demand highly developed project leadership skills*." [37- TELFER, Vol 24, Jan/Feb 2018] The second is to hold the PL accountable, making the PL look to be accountable for what has to be done, and is being done. This implies that executives also hold themselves accountable for having chosen the PL and for providing the needed 'fertile ground' in which the PL can succeed.

BHPs cannot be governed like other large projects. They have too many people, too much is involved, require too many different reports and decisions made by too many people at too many levels. So, a well-defined specific project governance structure, may be different from the standard organizational governance structure, but must define who has what authority (including input authority) and accountability. This list of stakeholders must include the PL or replacement for the PM; the Independent Reviewer, Reporter and Quality Assurance Lead (IRRQAL); the Business Lead and Project Champion (BLPC); the Executive Oversight Committee (EOC); the Organizational Transformation, Stakeholder Engagement and Deployment Lead (OTSEDL); and finally, the Specialized Boards of Excellence (SBE) managers who report to the PL. This new project governance model is as necessary as the customized development methodology.

For these governing teams, management competence is necessary and better management of everything but the development team members (who need less management and more leadership) is crucial, but no longer sufficient. If success is to be the only option then project governance must assure that steering does not replace oversight, reporting does not replace

doing, issues are embraced as opportunities to change for the better, decision are made quickly, and accountability serves to incentivise delivery, better cost management, and on-time delivery. Project governance must focus and keep focusing on expected business outcomes and success factors, not on system outputs. The organizational relationship of the key leads and stakeholders and a description of their roles and responsibilities is as follows:

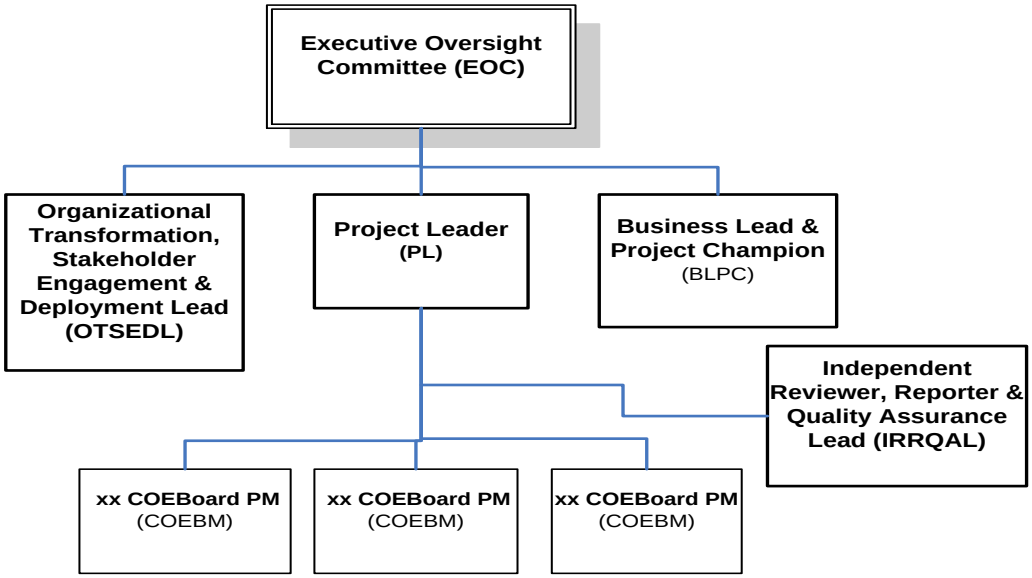

Diagram #1: The Organization of a BHP Development Team

Executive Oversight Committee (EOC)

The EOC is accountable for the financial and human corporate resources that will be invested, as well as for diverting organizational capacity to this project. It is accountable for approving the Project Complexity and Risk Assessment (PCRA) and for ascertaining that the organization has the capacity to undertake the project. This includes examining holistically in the enterprise context, the solution and assigning accountability for its alignment and support of the corporate strategy, its support of the achievement of expected outcomes, as well as the project's viability, to the Project Champion. Contrary to the situation in many organizations, the EOC is not set up to make the decisions that lower level SMEs are better suited to make but to facilitate lower level SMEs to be able to make their decisions. The role of the EOC and its eager executives, is to minimize any steering away from the original intention, that was provided by the BLPC, to facilitate needed changes to the solution and/or the project plan that have become evident and to enforce the accountability of those who must assure that the expected benefit will be realized. Their role is not to manage costs that the Project Champion is responsible for, but to assure that costs do not spiral beyond what the organization can afford and significantly harm the viability of the organization and other projects.

Project Leader (PL)

The BHP Project Leader (PL) is more like a project CEO than a PM, with authority to decide how to design and build the technology part of the solution that will take the organization from where it is today, from present capability and outcome to the future state. Due mainly to the size of the project and the large number of people on the project, the PL's responsibilities on a BHP are different than the traditional responsibilities of the PM. The PL must establish and lead the unique team, composed of groups/teams, establish and maintain positive and supportive relationships between these groups/teams of people to 'smooth the way', drive towards the business outcome and communicate, communicate, communicate, this being more important than, hold your breath, adhering to the standard methodology. Delivering on-time and on-budget the full requested functionality, as per a Requirements Traceability Matrix, is not the measure of the PL's success, even if these variables are useful or necessary in planning and task delivery. *"For the past 40 years, for example, we've tortured ourselves over our inability to finish a software project on time and on budget. But this never should have been the supreme goal. The more important goal is transformation, creating software that changes the world or that transforms a company or how it does business… Software development is and always will be somewhat experimental."* [32- DeMarco, 1995] Large complex projects need leadership to engage, collaborate with and influence stakeholders, build high performing teams, facilitate the evolution of the solution while maintaining expected benefits, integrating contractor relationships, develop the system and build the necessary organizational capability and capacity to attain the expected outcome, validated by measuring performance. It is not conforming to: "… *IT projects … delivering 56 percent less value*." [17- Bloch, Blumberg & Laartz, 2012] The PL reports to the EOC, and guides the development of a system that will enable a vision or a new paradigm to be deployed.

Too often the role to lead a large, complex project that requires a great number of team members and specific experiential skills and knowledge is assigned to PMs who happen to be available but not necessarily suitable for the role. This undermines the importance of having the right leader, which may be the most important of the many mistakes organizations make in undertaking a BHP. BHPs need adaptable PLs who are ready to learn not methodology savvy PMs, because the team is more likely to be composed of knowledge workers than blue collar workers, and the work will most probably have unexpected surprises. While verifying the time that staff recorded on their timesheets is considered a necessary management function by many PMs in many circumstances, it is not a PL task. It speaks to output, efficiency and is a de-motivator for knowledge workers who are focused on the task and on achieving effective results, not on the time they spend to achieve it, which is often more, not less than required. BHPs need visionary, decisive and dedicated PLs [11- Shared Services Canada, 2016-10-04] who do not sprint but plan on reaching the end result, can form teams (of PMs), keep the PMs on the team until the successful end and lead others to be more successful than they could have been

otherwise. These PLs will have the authority that they will need in order to succeed, because they will insist on it and take it, weather it was given to them or not.

Independent Reviewer, Reporter and Quality Assurance Lead (IRRQAL)

The IRRQAL is above all, an independent reviewer of the technology project, i.e. the BHP or program, although not quite a verifier and validator. In this role, the IRRQAL has to look for any overlooked indicators that something has negatively impacted or may impact the project. The role is not to find problems but to identify areas that need attention or action from the PL or EOC, (i.e. document who will do what, when to arrive at what) in order to avoid problems from occurring. Secondly, this position is accountable for reporting on the progress of the projects that constitute the portfolio or program (i.e. the sub-projects if the BHP is subdivided instead of being assembled), and especially overseeing the Benefit Realization initiative that reports on earned value the organization wants to achieve (which is only done in a third of the organizations), and was documented in the business case. The IRRQAL is also mandated to report on organizational portfolios, to help prioritize projects.

This offloading from the PL (or PM if the latter is not replaced), facilitates the expected reports (Project Plans, Project Schedule updates, Dashboards, Program SME Team Leads' updates (e.g. Stakeholder Engagement Lead, Audit Lead, Benefit Realization Lead), status Reports, PMO Compliance and the like) to be fairly complicated, complete and accurate, and to include complicated calculations like earned value, position on the critical path, contractor management, expected earned value in the future or organizational benefit realized, and the like. While the PL of the BHP still retains accountability for the data used for the reports, which is based on project achievements mapped against the schedule, the IRRQAL is responsible for producing the analysis and for elaborating the reports. This relieves the PL's workload, which usually prevents the PL from producing all the progress reports, in as much detail, based on as much analysis of a concerning situation, and as often as executives and stakeholders need them. Were the PLs to have to produce these reports, the time spent on leading the BHP would suffer. However, the IRRQAL also has a related and distinguishing role. He/she is expected not only to report on past achievements but also to predict the future. This includes the quarterly risk evaluation and prediction of the probability of success, the expected final costs based on current 'burn rates' and the achieved benefits expected, using recent decisions. The final role of the IRRQAL is to assure that the quality of the project is, what it is expected to be. [38- Villanyi Bokor, 2016]

Business Lead and Project Champion (BLPC)

The BLPC holds a similar position to that of the traditional Business or Project Champion of large projects. The BLPC is the person who, or group that is accountable for deploying a solution that includes a system; who will be held accountable for reallocating (spending) precious limited organizational resources; and who will be held accountable for the outcome attained in comparison to the expected outcome(s). The BLPC is and must be held accountable

to the EOC, for any significant changes they decided to make to the approved solution, business case and project charter, and for any significant impact that these requested changes had on the ROI / benefits realized. Having such a responsibility facilitates the BLPC to make changes to the solution (to requirements) as needed while keeping the EOC to whom they report, involved, so that the latter can keep total costs from escalating above what the organization can afford, or can reallocate limited resources that can be better used elsewhere.

Organizational Transformation, Stakeholder Engagement and Deployment Lead (OTSEDL)

The OTSEDL is accountable for the organizational change management strategy and plan needed to deploy the solution, as well as for deploying the needed business transformation. This is to include the people and processes, usually mentioned in the 'people, processes and technology' trilogy. But it also includes communications planning, communicating to facilitate people to forget the old methodology, engaging future users, introducing the new way of working, and why it is needed and why it is good for all. This role is not only to provide the needed training, but also to develop the users' needed capability which focuses on the effectiveness of the provided training, not weather training was or was not provided. In other words, this makes training without the trainee learning and then engaging, insufficient. As the focus of the OTSEDL is to deploy the solution, this person or team reports to the EOC not the PL.

As many BHPs (think portfolio or programs) involve major business transformation or changes to existing paradigms, their risk of failure is not only from the IT project failing. To a greater degree, BHPs can also fail due to transformation related risks, like one or more of the new systems not being used by the intended users (lack of engagement). Blaming IT for unsuccessful BHP deployment is too simplistic and incorrect. IT simply develops and implements the system that facilitates and/or enables the business solution. The OTSEDL is accountable for deploying the solution, which includes having intended users using the solution. When this is done badly, this also can fail the project.

SBE Manager (SBEM)

IT workers on large complex projects are knowledge workers. They have the expertise and the experience in their specializations that many of their supervising managers do not have. They need intrinsic motivation to engage and stay on the project. Badly managed teams will produce less than what the team is capable of producing under good leadership. This in part is why developers need to work in Centers of Excellence (CoE) that are managed as boards or Specialized Boards of Excellence (SBE) and thought of as 'expert tribes'. Based on empirical evidence, the performance of knowledge workers formed into SBEs is exceptional due to the passion, drive, and the team's willingness to work together. SBEs do not always conform, but often innovate and accept to be held accountable for the required outputs they are mandated to deliver and for assuring that their outputs' integrate with the rest of the projects' (in the

program) outputs. But this depends on how they are led by the SBE Chair or PM, who reports to the PL and is elected by the SBE's members.

Colleen Barrett was executive vice president of Southwest Airlines, from 1990 to 2001. [40-Gino] She established the goal of allowing employees to deliver the legally required safety announcement in their own style. This philosophy helped make Southwest a top industry performer in terms of passenger volume, profitability, customer satisfaction, and turnover.

3.6 Investigate the Organization's Capacity and Capability

Say a home owner wants to redesign the front lawn of his/her house, and wants to put a large nine-ton rock in the corner of the lot, beside a tree with the house's number etched on it. Let us say he/she rents a shiny four-wheel-drive truck with leather seats and hi-fi stereo to bring the rock home with. What information is missing? Well for one, the assurance that the truck's axle can handle a nine-ton load, i.e. that the truck has the necessary capacity. For another, the strategy to get the rock onto and off the truck, i.e. the capability as in skill, education, experience, intelligence. Overlooking these two essential elements and not having the capacity to carry the weight and/or the capability to load and unload the truck may make this task impossible to execute, even if it is desirable. Further in this vain, if the truck is to be used to bring 12 tons of bricks to the site, the truck's carrying capacity, i.e. weather it is ten tons or thirteen, will determine the time required to take this load of bricks from one place to another. To be able to develop a BHP, the PL must know the organization's capacity, such as the number of projects it can undertake simultaneously, as well as its capability, such as the complexity of the project that the resources are capable of developing.

3.6.1 Capacity

There is a maximum number of projects that an organization can undertake simultaneously and deliver successfully. The problem is that the number of projects that an organization considers it can develop and deliver simultaneously, is a higher number than the number of projects that it can undertake and deliver successfully. Wanting to develop 30 projects is not the same as being able to do it. If the organization attempts a portfolio that exceeds its capacity, the excess will overwhelm the organization's capacity, and alas, fewer projects will be delivered successfully than the organization's capacity otherwise would allow. All organizations have a maximum capacity and generally it is neither considered nor known, when the desirability of a project is being discussed. There is a maximum number of projects that an organization can undertake simultaneously and deliver successfully. The problem is that the number of projects that an organization considers it can develop and deliver simultaneously, is a higher number than the number of projects that it can undertake and deliver successfully. This development capacity is not only dependent on the number of developers available, but also the location of the seats where consultants may be seated, the executives' time that is available to provide project oversight, the stakeholders' time to validate the outputs, and financial resources set aside, all of

which are limited. This capacity impacts the time it takes to make decisions, hence it impacts the project's costs as delayed decisions delay projects. In addition, as working on project oversight requires both executives' and the stakeholders' time, their oversight tasks reduce their time to do their jobs. Thus, adding a BHP into the organization's portfolio of projects, can easily spells the BHP's or some other project's (projects') failure and too often it does. Inadequate capacity can make a good idea become a nightmare.

Empirical evidence suggests that in general, organizations set up for success, cannot have more than one BHP or more than (about) seven major concurrent projects active in their development portfolio. Like the length of telephone numbers, or numbers on license plates, we have trouble dealing with lists greater than seven (tied to our channel capacity that George Miller has talked about). This may be more easily understood than heeded to.

3.6.2 Capability

Having the capability that is required for a project, means that the necessary recruitment process that selected, contracted or hired the developers, the in-house training and the people assignment processes are effective. This is what most often is not talked about. However, assuring that the capability developing tasks are well done is an integral part of the new framework.

An unfortunate but debateable finding is that while a PM experienced in developing projects has experience in developing projects, a PL who has experience and worked on a specific BHP has experience on that specific BHP, that specific methodology, using that specific project governance structure (identifies the responsibilities of decision-makers, escalation paths for critical issues, how risks are identified and dealt with, and how change is controlled), in that specific development environment. In other words, having lead a BHP, while it is desirable, does not guarantee that the PL has the ability or knowledge to lead a different BHP in the same organization or the same BHP in another organization, where the specific methodology, project governance, development environment are different. BHPs are unique and the PL's approach or methodology must also be unique. Thus a PL's experience leading a BHP, alas, is not sufficient to guarantee success. Arguable, as all radical ideas are. PLs having inadequate or the wrong skill and experience, even if it is superb, or not 'click'-ing [41- Brafman & Brafman, 2010] with project staff and the organization's executives, is a major reason they fail projects. Charisma may be more important than the standard development methodology, another arguable point, for PLs. Assuring a well-founded PL selection process is an integral part and the responsibility of the new development framework and the responsibility of the EOC.

Based on the above, the organization, most specifically the EOC and the BHP PL, before deciding to undertake or not to undertake a BHP, first and foremost must assess and determine the organizational as well as the project's capacity and capability.

3.7 Customize the Development Methodology

The standard 'water fall' SDLC and project development paradigm does not work when it is used to develop BHPs. A new approach and one that is specific to each BHP is needed. Statistics and examples prove it. Being able to develop a BHP the same way that we develop other projects is as highly desirable as it is unrealistic. Wishing that its number of functions, its number of developers, its development environment and its project governance structure will not require a different and customized approach, does not change our lessons learned, which indicate that they will (require a different and customized approach). Wishing to complete a project life cycle phase, i.e. conception, initiation, planning, analysis, design, construction, testing, production/implementation before the next phase is started is logical, common sense and as highly desirable as it is unrealistic when the project is a BHP.

BHPs cannot be developed with a PM using the standard project management paradigm, and when they are so attempted, they are generally, barring luck, unsuccessful. These projects are very large and have too many function points and consequently LOC, to be intelligible, unambiguous, and comprehensible. So, to deal with an unintelligible system, these projects are subdivided thus changing their functional complexity for sub-project interface complexity.

BHPs have development and management teams that are orders of magnitude larger than the size of teams we know how to manage and align effectively, and these teams keep growing during the SDLC. In addition, the standard governance does not work effectively with such a large development team and knowledge workers, or handle well the numerous formal and informal communication channels, that these projects need. As an example, in many governance structures, the development team cannot make the decisions that it is best equipped to make. So, making these decisions is transferred to the oversight team which often does not make the decision because it is overwhelmed with work, much of which is due to requests they have that they should not be involved with and requests for decisions they should not be making. Specifically, because there are many oversight and steering committees, sometimes with too many people on them, often no one is accountable for the resources spent, and hence resources are misused. This result in the cost of a BHP spiraling to over 300% and may be to over 5,000% of its initial budget. In addition, this cost will only be about one third of the total cost, as over half of the allocated development budget will be spent on project administration not project development although little if any of this cost is included in the original estimated budget. Thus, often while costs are rising and executives are not able to foresee the end cost, the earned value of the outcome is generally decreasing resulting in much effort and cost being spent on debating the future of the BHP.

While a 'water fall' development methodology may be adequate for most projects that have a clear set of mostly stable requirements and static schedule, a BHP rarely follows the sequential flow and needs a unique, customized development methodology and an iterative or prototyping SD^2LC, i.e. an SDLC that replaces the 'development' cycle with 'design and development' in the life cycle. Following its initial conceptual design that is based on a desirable solution, a BHP

needs to deal with uncertainties and be developed in four consecutive cycles (could be termed development stages). This may be arguable by those who support Agile, and who reject the claim that: "… Agile is not … well suited to large development projects. This is particularly true when the project's schedule is tied to deadlines ["Deadlines are not part of Agile."]…" [42- Hamilton, 2015] "The use of in-house methodology seems to give the best rate of project success….. and seem to have been more effective than the generic [referred to here as standard] PRINCE2 or *PMBOK® Guide* methodologies." [43- Carroll, 2006] The above mentioned four consecutive cycles may be redefined as six cycles, if the first two of the four cycles are divided into two each, without changing the concept proposed. While it may sound as if the iterative methodology is similar to Agile, which in many respects it is, unlike Agile each cycle may take months to complete and each is focused on delivering a working and evolving system, in cycles rather than by functions. In addition, each has a pre-defined schedule.

3.7.1 Change the PM for a PL

The first and foremost *sine qua non* necessity, even if not a sufficient requirement for successfully developing a BHP, is to change the PM for a PL. As BHPs have many teams that need to be developed and lead, and many stakeholders to align, a leader is as necessary as a manager. "Only three things happen naturally in organizations: friction, confusion, and under performance. Everything else requires leadership." [44- Drucker, 2013] So, BHPs need visionary, decisive and dedicated PL to deal with friction, and under performance, while developing projects that support a change in the organization's operating paradigm. [11- Shared Services Canada, 2016-10-04] To communicate effectively and be willing to accept the implied accountability of the position, is more important than the need to reach consensus and satisfy the organization's administrative needs. [45- Kotter, 1990]

So, a BHP needs a PL who understands the vision, can illuminate the direction, enthuse the project's teams, and move forward more than manage the updates to a static project schedule, report on status, approve timesheets and point to delivered outputs. Unfortunately, in many (government) organizations, disqualifying senior and experienced PMs is difficult and basing it on the size of the project is next to impossible, even when these PMs are producing disastrous results. The PL must inspire, create and sustain teams, and promote cooperative relationships amongst the many sub-project PMs (i.e. sub-projects if the BHP is subdivided not assembled), involve and guide executives and acknowledge, react to and correct mistakes that he or she will (not maybe) make. [45- Kotter, 1990] While a BHP directed by a 'seasoned' PM will succeed to deliver some of the requirements, one directed by an 'incompetent for the size of the undertaking' PM has no chance and will deliver no value.

The BHP PL has to blur the walls between the silo where the project is being developed (usually the CIO's group) and the silo of the LoB that the BHP is responsible to improve or enable. To do this, the BHP PL has to communicate with the BAs who have elaborated the business' needs

(i.e. detailed business requirements (DBR)), with customers who need to be involved and who are authorized to ask for on-going changes. BHP PLs have to work with the organizational change management analysts who are entrusted to deploy the organization's and employees' capability to achieve the expected outcome, which in the case of a BHP is the vision or the new paradigm. This can only happen, if the BHP PL has adequate authority, accountability, can make decisions and lead.

The hardest part of leading a BHP is to understand that it is not about managing the project and that past success is only half of the required expertise. Leading is ascertaining the organizational capability, organizational capacity, the capability of the people on the project and leading the team that includes executives and stakeholders. Problems arise when BHP PLs think they know how it will go, because they do not, and when they are the best at doing what the SMEs are asked to do, because they are not.

3.7.2 Use a new development methodology

BHPs cannot be developed, as many projects are, using a standard development methodology that is focused on producing pre-development defined outputs, based on a set of relatively fixed (and analysed to death) business requirements. This is the second essential element when considering whether to customize the development methodology. Each BHP needs a unique, iterative and flexible methodology, customized to the project and its environment. Therefore, the PL has to start by taking the corporate project development methodology or framework and customize it to the unique requirement of the BHP and the organization and focus it on producing the expected outcome. The difficulty here is that if the PL is merely a PM, is inadequately aggressive or the 'standards police' in the corporation or the PMO is overly protective of the corporate standard development methodology (i.e. demands that the pre-defined methodology or framework must be used), the customized development methodology will not be any better than the standard development methodology that, as discussed, is inadequate. If the customization is to be effective, it has to be based on the constraints presented by the project, the available leadership, the development environment, specifically the project governance and decision making that allows stupid decisions to be retracted (e.g. the PL cannot pursue an MBA while attempting to develop a BHP), the organizational capability and the existing organizational capacity. Once the PL defines the new and unique methodology and it is accepted, the organization led by the EOC needs to rally around the PL and not change the PL mid-project, barring unsatisfactory performance.

This methodology has four iterative execute cycles in which to develop the project, post its Initiation, Planning and first conceptual design (see blueprint, a model of the future organization that delivers the expected outcome) of the solution. The first execution cycle, referred to as the Vital Cycle I, is to develop and deploy a workable pilot version of the system, using only or mostly the vital (i.e. *sine qua non*) functions of the BHP. In other words about 20% of the

requirements that are normally defined in a standard methodology (generally called Detailed Business Requirements (DBR), and generally believed to be all the users' requirements). This pilot version of the system (i.e. bare bones of the eventual) is to take the organization or existing system from what there is 'today' to the 'vision' for tomorrow, the outcome. The goal of this output is to demonstrate the feasibility and the value of the paradigm that the BHP will facilitate and/or enable, and showcase why the BHP is undertaken. It is to be a value-added foundation of the solution, not a part that does some things not others, or a 'throw away'.

The second cycle is a Validation Cycle II that has three objectives. First, it is to test the pilot system / technology that was developed in Cycle I, including the associated business processes, and information availability they facilitate and/or enable, and demonstrate that the users are capable of delivering the expected outcome with this preliminary / pilot solution. Secondly, it is to perfect and hone the deployed vital functionality of the pilot. Learning never stops. Finally, it is to develop and deploy the remaining needed functionality that supports the solution, and that along with the vital functions will add up to around 50% of the requirements or functionality that would have been identified by the standard development methodology. This new additional functionality will complete the business' needs. Note that some projects identify vital, needed and wanted functionality as mandatory, desirable and optional functionality.

Separating the vital functions from these business needs, improves the functions, as users, due to the size and complexity of the project, are better able to define all requirements when viewing progressive prototypes. This approach is focused on delivering expected business outcomes by developing projects that meet customers' needs, are delivered at minimal cost, minimal waste and faster.

Following the live testing of the pilot and its honed functions, and after the needed functionality is developed and deployed, this second cycle is to conclude with an interim performance evaluation (IPE), to showcase the success and cost benefit of the project.

The third or the Completion Cycle III, is to validate that the needed business functions were deployed and were integrated into the business solution. This is business supporting quality assurance. This evaluation will include a gap analysis between the developed system and the complete list of requirements. It will validate if most of the organization's business needs to attain the vision have or have not been met. Subsequently, reminiscent of the waterfall approach, a plan to enhance the design with the final set of requested and/or desired, and arguably optional functions, that the gap analysis has uncovered can be elaborated, once the list of all requested but not yet delivered functions are agreed upon. This third and last set of functions are those that have not been considered earlier to be vital, needed, or cost effective. They will never or hardly ever be used by most people, and will only be used by very few people.

The fourth and final development cycle is the Enhancement Cycle IV. It is designed to make the solution easier to use, more appealing and a better fit, without necessarily making the system

enhancements a better investment or yielding a better return on the investment. It is also, to develop, deploy and test the optional and to be infrequently used functionality. This last cycle concludes with rather than being followed by, a performance evaluation of the BHP. It measures the key performance indicators to demonstrate that they are met, calculates the cost to benefit of the outcome and conducts an analysis of the new organizational capability to attain the vision.
This iterative development methodology assembles projects to form a BHP rather than subdivides a BHP into sub-projects. Similarly to the Agile approach these BHP development cycles promote an incremental delivery, are open to consistent customer input and changes (see CCRM), and focus on helping the customer. Unlike the Agile approach however, this methodology plans the entire list of (vital) requirements to be developed, allows a longer-term planning as they each deliver larger 'chunks' of the project and is scheduled ("Deadlines are not part of Agile."). This approach develops, implements and deploys in cycles, unlike the 'Big Bang' approach which is highly unrealistic even if it is desirable. It also only delivers about half of the function points thus reducing the project's size, cost, complexity and maintenance. While this approach seems too long and unattractive, empirical evidence suggests it takes about 70% more time than the traditionally estimated time to develop the BHP by using the standard development methodology. However, that is about 15% less time than the 'two times the originally estimated time' that BHPs normally actually take. [46- Pfeffer, Sutton, 2000] Thus this is faster. While this may not be the only methodology that can be used to develop a BHP, it is one of the methodologies that can replace the standard methodology which is not an option and which must be changed. Just as introducing a standard methodology improves project management in organizations where a methodology is not currently used, this new BHP framework on which a unique new methodology and governance structure can be built, may also facilitate non-BHP projects to be more consistently successful.

IV. CONCLUSIONS

We do not know how to develop enormously large and consequently complex systems, but as we think we know, we attempt them and we fail them by design. As few organizations or PLs seem to consider this to be a problem, few are looking for a solution. As Deming (W. Edward) said: "It is not necessary to change. Survival is not mandatory."

Very very large-scale IT projects take too long, are more expensive than expected, and fail to deliver the expected benefits. This does not need to be the case. Companies can achieve successful outcomes by having systems development and the lines of business join forces in a commitment to deliver value. Despite the disasters, large organizations can engineer IT projects to defy the odds. [17- Bloch, 2012]

We need to use a new governance structure, a new development framework and change how we engage and lead developers by using Project Leaders for very large projects. These changes, if deployed, would change how we manage very large projects This is not an option. Reluctance to

change and wanting to do better with the methodology we already have, stands in the way of change and achieving excellence.

It is disconcerting and maybe a tragedy that we listen to the learned opinions of doctors and lawyers, but that the leaders of our very large projects do not merit and/or are not of the professional calibre to be listened to. This may be because PLs do not always base decisions on available facts, but were facts always available, we could get a personal computer to make decisions. As it is, we lose out on not heeding learned opinion and non-verbal communications.

Some projects are too big and consequently are too complex for our standard methodology. So, an extended framework not tweaking of the present *modus operandi* is needed. We need a new framework that can be the basis of a unique methodology designed for each BHP. Unlike our standard output focused methodology this must focus on achieving the expected outcome, and incorporate: changes to our tolerance for even smart people, to do stupid things; an analysis to limit project size and complexity; using a unique methodology and project governance structure; and working within organizational capacity and capability.

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Acronyms

API	application program interfaces
BHP	Black Hole Projects
BRD	Business Requirements Document
CCRM	Customer Centered Requirements Management
SBE	Specialized Boards of Excellence
IPE	interim performance evaluation
IT	information technology
QA	quality assurance
LOB	lines of business
PCRA	Project Complexity and Risk Assessment
PL	Project Lead
PM	Project Manager
QA	Quality Assurance
RCM	Requirements Change Management
S.E.I.	Software Engineering Institute
SDLC	system development lifecycle
SD^2LC	System Design and Development Life Cycle
SSP	Super Sized Projects

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