This paper is being presented to highlight, in general, the critical nature of project integration in project management and, specifically, in a telecommunications environment.

This presentation looks into practical integration situations in telecommunication projects and the strategies developed for overcoming them. It will also offer hindsight into various types of telecommunication projects with both fixed and mobile operators.

Project integration is

- Integration of all aspects of projects: objective, cost, schedule, systems, and processes
- Integration along all life cycle phases of the project and its deliverables
- Integrating concerns of all stakeholders into project objectives
- Integration across all the vendors
- Integrating project management processes and functional processes

Background
In my opinion, project integration is one of the most difficult areas in project management. This is even more difficult in a telecommunications environment in which integration is required within IT systems, network systems, and between IT systems and network systems. Most of the projects involve working with multiple suppliers and integrating the work done by them. In addition, an average telecommunications project will impact at least three of these systems.

Since the beginning of the twenty-first century, there has been a convergence of IT and communications in the form of information communication technology (ICT) in a telecommunications environment. In addition, telecommunications companies have been diversifying their networks of equipment suppliers. For example, Botswana was known as “Ericsson country” in the 1980s and 1990s. However, since 2000, BTC has embarked on a conscious policy of diversifying its vendors; consequently, BTC now has Ericsson voice switches, Alcatel Data switches, Huawei IN, and the Comverse customer care and billing system.

As such, project integration has become a critical aspect in successful project management. Any changes to business support systems or operations support systems will require some changes to multi-vendor systems. The critical path in projects is quite often the lead time for the delivery of changes, testing, and interface management.
Fixed versus Mobile Operators
Although both fixed and mobile operators operate telecommunications networks and provide services, there are significant differences in the nature of their projects:

- Fixed operator projects are more infrastructure oriented.
  Mobile operators, one way or another, use the network provided by the fixed operator. As the mobile operator’s network requirements grow, the fixed operator, in turn, has to introduce new infrastructure or increase the capacity on the existing infrastructure.
- The mobile environment is a highly competitive environment and, as such, the frequency for the launch of new products and services is much higher in the mobile industry and timelines are very tight. A project in the mobile industry is very much driven by marketing and sales requirements.

Historical Telecommunication Projects
Historically, telecommunication projects fall into two main areas and they are:

1. Network (infrastructure, switching, and transmission)
2. IT systems (billing, customer care)

Before 2000, there was very little automated integration between systems in these two areas. The metered process was used for billing, provisioning was manual, and suppliers were clearly defined. For example, Ericsson was the only supplier of network-related systems at BTC.

Y2K projects had a major impact on the telecommunications industry. Many of the legacy IT systems were decommissioned in favor of robust IT systems, which led to the introduction of the call data record (CDR) based post paid billing, auto provisioning, and prepaid intelligent networks (IN) billing. In addition, due to competition, customers wanted more choices for products and services.

Modern Telecommunication Systems
CDR Based Billing
In the case of post paid billing, a CDR is generated by switch when a call is made. CDRs are sent to the billing system via the mediation system. Mediation is used to format the CDR for the billing system. In the case of prepaid billing, CDR is generated by the IN.

CDRs are then rated and billed. CDR data are also used for interconnect, revenue assurance, and for other financial purposes. In a nutshell, CDR is used across multiple systems and, as such, any modification to CDR impacts multiple systems.

Automatic Provisioning
Prior to 2000, most of the telecommunication companies’ operators were manually provisioning customers on switches. The process followed was to activate/deactivate the customer in the billing system and, at the same time, manually send a request to activate/deactivate the switches. This process was cumbersome. In addition, calls could be made before billing was effected, which led to revenue loss. Automatic provisioning allows the customer to be activated/deactivated simultaneously in both billing and switching; however, this requires middleware in most cases in order to interface between IT systems and switching.

Prepaid Billing
Prepaid billing is real-time billing and, as such, it requires highly (IN) systems to interact with switches. IN systems are in a real sense IT systems that are able to interpret calls made in the network. In addition, complex products and services have to be made available in IN systems. Although mobile operators started using IN systems a long time ago, fixed-line operators started using IN systems only after 2000. Any implementation or upgrade of IN systems requires integration with both customer care and switching systems.

Real-Time Billing
Customers require real-time billing (i.e., billing information as soon as a call is made), which requires real-time rating and systems to provide balance inquiries. This requirement spans across multiple systems, from switching to billing, customer care, and interactive voice recording (IVR).

Products and Services
Both fixed and mobile service providers are offering a variety of products and services to attract and retain subscribers. In order to launch the products and services, projects are initiated across multiple systems and suppliers. It is known that the success of projects in terms of time and budget is very critical for the company in order for it to retain its competitive edge.

Content Value Chain
In content value chain, subscribers send a short messaging service (SMS) or connect via a hyper-text transfer protocol (HTTP) to a content provider to download content. The content provider is called a wireless application service provider (WASP). The content value chain consists of multiple systems, such as the short message service center (SMSC), routing engines, and rating/billing systems. All these systems are real-time and should be able to handle large
Implementation projects would require a high level of project integration between a multitude of host systems from different vendors and external service providers.

**Vendor Diversification**
The telecommunications industry has embarked on a deliberate policy to diversify suppliers. In the past, one major supplier provided the complete solution. The solution could have come from base stations, switches, and billing; however, diversification has led to each of the functions being provided by a different supplier. For example, the base station from one supplier switches from another and so on. In addition, within a function, there are multiple suppliers (e.g., some base stations can be supplied by Ericsson [E/], and others by Huawei; within billing, retail billing by CSG, and content billing by Portal and so on.)

Diversification means that in projects spanning across different suppliers, the project manager has to manage a multitude of suppliers from different backgrounds (i.e., telecommunications and IT). Each of the suppliers has its own methodology and documentation and even though they may subscribe to the same methodology, the documentation and terminology can be different.

In addition, as with any supplier, each of the suppliers has its own objectives. In many cases, suppliers tend to maximize the role and efficiency of their system and look for opportunities to undermine other systems. If an interface does not work in testing, blame will be passed back and forth between the suppliers and the project manager will be caught in the middle. In this type of situation, it is essential for the project manager to have sufficient technical knowledge of the project or to have a technical architect to assist the project manager in managing the suppliers. Another approach is to have a commercial project manager and a technical project manager or integration project manager.

**Internal Dynamics in Projects**
Although every project has internal dynamics to consider, a typical telecommunications project has the following internal dynamics:
1. Client (business) versus service delivery (IT/network)
2. Within service delivery/IT; architects versus operations
3. Cultural diversity

In the first case, the struggle starts with the business requirements. The client’s interpretation of business requirements could be diametrically opposite of the service delivery’s understanding of business requirements. By the time the requirement reaches the supplier, it has undergone various interpretations and ultimately the supplier delivers something that is totally different from what the client wanted. This is normally discovered during the user acceptance testing; after mutual recriminations, systems are redesigned, and this wastes time and money.

The best approach in this case is to ensure synchronization from the start. When the client stipulates requirements, they are documented and negotiated on in a workshop until both the client and delivery functions are in sync. When designs are prepared, they are explained to the client and preferably with a snapshot of Graphical User interface screens, and so forth, and the same process is repeated with the supplier. The supplier may be asked to provide a proof of concept or prototype, which is then verified by the delivery function and client. In addition, a pilot project could be executed. In a pilot project, a lean version of the project is executed. For example, in the case of a new system to be implemented in the pilot project basic system, the hardware and software are installed and their functionality is tested. Once the functionality testing is successful, the complete system is ordered and implemented.

The second case is as important as the first one. Within service delivery, there will be always conflicts between architects and operations. Architects tend to be proactive with new ideas, whereas operations has the experience and is cautious; in a project, architects favor change, but operations prefers not to make major changes.

It is important that both parties participate in the project team and it is the project manager’s responsibility to integrate the two positions; the project manager could use this conflict positively and derive the synthesis. It is important that every new idea be thoroughly scrutinized. Operations and testing play major roles in vetting the ideas. Due to their considerable experience, operations and testing teams are in a position to scrutinize the concept and, ultimately, a thoroughly vetted concept will evolve; operations has experience with the suppliers and can assist in the process. In addition, involvement of operations and the testing team from the start will bring about commitment and successful implementation. From the beginning of the project, every project team should have one representative from the impacted operations and testing teams.

Generally, due to workload operations, it may not be possible to commit resources to the project or there may be a need to commit less experienced resources; however,
this could be negotiated up front. It is also important to involve operations in the design, integration testing, and user acceptance testing.

Now, we will explore the third case. Cultural diversity in the organization and project team has a significant impact on projects; this aspect is ignored in many cases, because, to some extent, it contributes to the failure of projects.

We are living in a culturally diverse environment. Prejudices and views that exist in this environment are naturally carried into the work environment, particularly into the project environment. Building a trustworthy and sound working relationship between the project team and stakeholders is critical to the success of the project.

For example, consider a country like South Africa, where there is a history of racial and cultural prejudices and confrontations. In South Africa, a project team member from one racial or cultural group may have fixed perceptions about a member from another racial or cultural group and these perceptions hamper the progress of the project.

In many instances, the project manager is expected to be a medium of communication between project members due to mistrust arising from cultural prejudices. It is important for the project manager to rise above these differences and manage these contradictions.

**Interface Management in Telecommunication Projects**

Interface management is the most difficult and critical integration aspect in a project. Quite often, systems that are being interfaced belong to different suppliers who will easily blame each other when the interface is not working. When systems that are being interfaced belong to the same supplier, then the project manager must be very firm in ensuring that the supplier is the system integrator in this case and should resolve the issues. It is possible for the supplier in this case to bring its internal problems to the project and the project manager is dragged into resolving these issues to adhere to the timelines. It is important to identify these tasks up front and clearly ensure that the supplier is responsible for resolving the issues within the agreed on timelines.

However, the scenario is more difficult when the systems being interfaced belong to different suppliers. It is also possible that three parties are involved in the middleware, as shown in the following diagram.

In the diagram we can see that five vendors are involved. Any upgrade of the billing system will mean a direct impact on mediation, provisioning, customer relationship management (CRM), and middleware; in addition, there is also an indirect impact on switching.

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**Figure 1: Provisioning and Call Data Record (CDR) Flow Diagram.**
This means that modifications may be required on middleware, mediation, provisioning, and CRM. In addition, system integration testing will have to be done. Most likely, issues will be picked up during the system integration testing, and because the systems are from different suppliers, timelines will be impacted. How do we address these issues up front?

It is important to have complete and thorough impact analyses on all the impacted systems and these should be done at the start of the project. During the impact analysis, each of the impacted systems is studied along with all the required changes, and the impact, and its associated risks are documented. In the absence of an overall system integrator, all the impacted vendors and/or operations teams should be involved in the impact analysis study. It is important that the impact analysis be detailed and not just a high-level study. Once the study is completed, all the impacted parties should sign off on the changes required. Once the development has started, interdependency of systems comes into place. Any new changes to the primary system (in this case, billing) will now impact the development of changes to other systems. The project manager’s role is very critical here. As soon as the scope changes on the primary system, the project manager should manage the changes to the scope for other impacted systems. This should be done through iterative impact analysis and updating of the original documentation; as such, the project manager is also acting as the change manager.

When issues are picked up during testing, it is important that the project manager react quickly and bring all the parties together. When a solution is provided, it must be tested as soon as possible, which is a long process that requires many iterative steps until all the issues are resolved. It is beneficial if the project manager has technical knowledge in both the primary system and impacted system; the project manager can then carry out independent investigations and come to a conclusion in the event of a stalemate between the suppliers.

Alternatively, the project manager can seek assistance and/or advice from independent technical experts in resolving issues between the suppliers.

In all events, the project manager should be perceived as being neutral and impartial regarding the impacted suppliers, in which case, the project manager will have the confidence and trust of the suppliers. Once the impartiality is compromised, it becomes difficult to find a solution acceptable to all the parties.

**Generic Project Requirements**

**Executive Sponsor**

It is essential that highly integrated projects have a project sponsor at the executive level, which implies support at the executive level. This will also ensure the participation and commitment of all the impacted functions. In addition, having a project steering committee with a high level of participation will ensure that strategic issues are discussed at the highest level and resolved.

**Project Definition Document or Project Initiation Document**

A project definition document is an encompassing document and the most important document in a project and consists of the following sections:

1. Objectives
2. Scope of work, exclusions, and interfaces
3. Project approach
4. Constraints
5. Assumptions
6. Project organization
7. Risk matrix
8. Project quality plan
9. Configuration management plan
10. Project communications plan
11. Acceptance criteria
12. External dependencies
13. Contingency plan
14. Project tolerances
15. Work breakdown structure
16. Project schedule
17. Project controls

In a nutshell, the project definition document covers all aspects of a project. In addition, the document is agreed on by all the stakeholders and binding for all the stakeholders; and, as such, it is very critical for successful project integration.

**The Golden Rules of Work Breakdown Structure**

Much has been written about work breakdown structure and its techniques. Work breakdown structure is critical for successful project integration.

1. Work breakdown structure is not rocket science. Everybody does work breakdown structure all the time, although it is not called that. Most of the time, we organize our work in our heads and it works well. However, when it comes to projects and, specifically, complex projects that involve other functions and vendors, it is important to organize on paper and this is called work breakdown structure. Work breakdown structure enables the project manager, supporting staff, and impacted functional managers to think through all the elements of the project.
2. The project manager has to use his or her judgment in creating work breakdown structure; however, the 80-hour rule helps. This rule means that each task should be broken down into sub-tasks, requiring no more than 80-man hours of work.

A Case Study for Project Integration: The Botswana Number Change Project

This project was initiated by the Botswana Regulatory Authority (BTA) to address the growing shortage of numbers within the number range available to zones in Botswana. Botswana had a closed number system and as such did not use area codes for zones. Botswana had six-digit numbers for each of its zones. A zone is a geographical area. The objective of the project was to introduce a seven-digit number system to each of the zones; in addition, the number of zones was reduced.

The project team consisted of local staff and expatriate staff. Due to failures in previous projects, there were mutual recrimination and acrimony between the local and expatriate staffs and managing internal dynamics was critical. There were also multiple vendors, such as Ericsson for switches and mediation and Kenan for customer care and billing. Literally every system and interfaces between them were impacted. End to end testing, starting from switches to the printing of bills was done.

The project was initiated in May 2000, with the set up of a program team. The team consisted of representatives from literally all the departments at BTC because all the systems were impacted. In addition to the introduction of the seven-digit range, the existing subscriber numbers had to be converted from six digits to seven digits according to the zone number range.

It was agreed that the city of Ramotswa would be the pilot zone, and the conversion per zone would be done in intervals of three months, which would have allowed for two full months of billing, with the new number range in the converted zone.

The project lasted for nearly three years.
The steps in this project approach were as follows:
1. The executive sponsor was the chief executive officer and the program manager was appointed
2. Impact analyses were done on all aspects of the number change: business, technology, and infrastructure
3. From the impact analysis, a project manager or project coordinator was appointed for every impacted function, system, and process.
4. The project manager was responsible for the remediation within his or her area
5. The program manager was responsible for the integration of all the projects and, as such, participated in all the project meetings.
6. The regulatory authority participated in the project meetings

Implementation of the project involved carrying out a number change in the selected area or zone, on all impacted systems, in one night, with minimal disruption to the subscribers. Technically, this meant de-provisioning and re-provisioning, sometimes one-hundred thousand subscribers in multitudes of systems in only a few hours.

In spite of performance difficulties at the start, the project was completed successfully in early 2003 with a zonal change.

Conclusion

Project integration is a critical aspect in project management, which is even more pronounced in a Southern-African context. South Africa came out of apartheid only in 1994, but centuries of racial prejudice have still left behind misperceptions and prejudice in the workplace. A typical project team consists of members from multiple cultural backgrounds. Technical discussions can degenerate into arguments based on these prejudices and, as a result, the project manager has to ensure the team is cohesive. It is also important that the project manager remains strong, independent, and objective in this type of situation. The project manager’s role as the integrator also means making decisions and implementing them while taking into consideration the cultural diversity of the team.

In a multivendor project, the client’s project manager is expected to be totally impartial. In telecommunication projects, multiple vendors are the norm and quite often, the vendors are even competitors. The project manager as an integrator has to ensure that the client’s interests are protected while ensuring all the vendors deliver. In project meetings, in which multiple vendors are present, it is important to ensure that the discussion stays on course and does not degenerate into mutual politicking by the vendors. Sometimes it is important to have separate meetings with different vendors; in addition, if there are arguments between different vendors over a solution, the project manager should ensure the vendors sit together and come up with a single agreed on solution. Here, the project manager is rising above vendor politics as an integrator and enforcing control over the project.

Having the chief executive officer as the executive sponsor for the number change project was very valuable. The project was a regulatory requirement and as such had fixed timelines.
With the chief executive officer as the executive sponsor, the vendor contracts were signed in record time and the purchase orders were approved quickly. In addition, because the project impacted both the IT and engineering functions, support and resources from these two functions were available without hindrance. Having a strong executive sponsor in a project will go a long way in ensuring its success.

Finally, project integration plays an important role in the adaptation of agile project management tools such as Kanban. Kanban is a manufacturing approach introduced by Toyota; however, in the past several years, Kanban has been used in agile development and project management. The project manager can set the work in progress (WIP) limits on the project, ensure that the project is visible, and establish a shared risk approach with the vendor rather than the traditional “threaten with contract” approach. As more and more projects are moving from the traditional “waterfall” approach to the “agile” approach, project integration will continue to play a critical role.

Reference
Please note that this paper is based on my own practical project experience and the knowledge gained from this experience; as such, there are no references to external materials, except for the 80-hour rule, which some research indicates, is one of Albert Einstein’s ideas.

About the Author
Pius Anton Christopher has been working in the project management field for more than 10 years and is a PMP and a CITP (Chartered Information Technology Professional) in the United Kingdom.

Mr. Christopher is currently a senior manager for Core Projects at Cell C, a mobile operator in South Africa, and started working at Cell C as a project manager in 2003. In 2005, he was promoted to program manager and then to senior program manager. He has implemented various billing, core network, and IT projects in his capacity as both program manager and project manager, and one of the billing projects reduced the post-paid billing time from 10 to 3 days.

In the period between 2000 and 2003 he worked for Botswana Telecommunications Corporation as a billing project manager, where he implemented billing, number change, and other IT projects, and he also remedied the post-paid billing system after the Y2K implementation failure.

In the period between 1998 and 2000, he worked as an IT manager for the air traffic and navigational services in South Africa. He also worked as a Y2K project manager and implemented the Y2K remediation of IT systems.

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