Philippine Government Common Platform (GCP)

Systems Description, Technical Architecture, Change Management Plan, Implementation Roadmap and Master Schedule

ICT Information and Communications Technology Office

Advanced Science and Technology Institute
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Executive Summary

This document serves as a concept paper for the Government Common Platform (GCP) and a guide in implementing the E-Government Master Plan (EGMP), which aims to integrate and institutionalize interoperability among government agencies by 2016 using a “whole of government” approach to processes and technology.

Objectives
The Government Common Platform aims to provide the architecture and framework that will help program champions, stakeholders and policy makers develop policies and create risk mitigation, change management and intervention plans.

It also aims to provide technical and process details as well as activities to aid program managers implement the EGMP.

Another objective is to provide a complete picture of the desired end to project managers and technical architects to use as a guide in design and processes.

This paper is divided into three sections:

Section 1 (General systems description) describes the GCP and how it works, and details the components essential to realize the objectives of the EGMP.

Section 2 (Change management strategy) details the activities essential to the adoption of the GCP.

Section 3 (Technical architecture) details the systems structure, approach and framework, and the various technology components that make up the future environment envisioned in the EGMP.

What is Government Common Platform

Section 1 of this paper gives the general description of the Government Common Platform (GCP). It is defined as a repository of data and information that can be accessed, shared and used by government agencies. In the process, the government agencies enhance their efficiency – and save money – by sharing resources, eliminating duplication of work, collaborating, and exchanging knowledge and experiences.

The GCP is a cloud-based technology that offers “platform as a service” to government agencies and private sector clients. It is a component of the Integrated Government Philippines (iGovPhil) project of the Department of Science and Technology, as implemented by the Information and Communications Technology Office (DOST-ICT Office) and Advanced Science and Technology Institute (DOST-ASTI).
The GCP aims to provide a whole-of-government approach to the diverse operations of agencies, while at the same time recognizing both their unique and common features.

Each government agency performs a function or a number of functions. Think of it as an independent planet that is part of planetary system, and this system is part of a greater galaxy within a larger system of galaxies or universe. That universe is the “whole of government,” which consists of not a single enterprise but a collection of independent enterprises. Understanding this leads us to realize that it is impractical to implement a “one-size-fits-all” model that will govern the interaction among government agencies and between agencies and the general public.

Government agencies do interact with each other, but this interaction relies heavily on the compatibility of their systems and applications and the inclination of their managements to share or exchange data and information.

Currently, there is no common platform for the entire government where agencies can share resources or data. Some agencies maintain their own databases and there is no system that considers the whole of government in sharing credible data and information on demand.

How the GCP works
The business problem the system intends to solve is: “How will government agencies share credible data and relevant information efficiently with each other on demand?”

Providing a single system of sharing and disseminating data and information for the whole of government is problematic and next to impossible because of the varied interests and functions of government agencies.

However, this can be overcome by organizing government agencies into collaborative groups based on the types of data and information that are relevant and meaningful to each of them. Turning participating agencies into federated collaborative groups will make the system easier to manage and implement. Each collaborative group can focus on valuable sharing or exchanges, eliminating those that are completely useless to the group’s services or functions.

So far, the project has identified 59 collaborative groupings based on areas of interest. An agency can become a member of more than one collaborative group.

The GCP will be set up in the Government Cloud and a GCP Office will be created in the future to manage and operate it. As the GCP will be housing sensitive government data, there will be layers of access for different collaborative groups in the structure. Agencies will access the system through their respective collaborative repositories and registries that are shared with the whole of government.
Change Management

Section 2 deals with change management. Change, as everyone knows, can be painful. That’s why there is a need to manage change to make it as painless as possible and acceptable to people who will be implementing the project.

A project consists of 85 percent human component and only 15 percent material or structural. This means that machines, equipment and other material things contribute only 15 percent to the success of a project. Human behavior is important in any project and must adapt to the new technology being introduced. Technology, after all, is just a tool and its value is determined by the people who use it.

The change management strategy for GCP is to invest sufficient resources and attention to the behavioral elements. For this, knowledge workers must be employed, as the job requires a shift in mindset, systems, and methods.

The section on change management also discusses the structure and composition of the future GCP Office (GCPO). It will be organized into a management group composed of five initial divisions, namely: the GCP Production Systems Division, GCP Project Management Division, GCP Systems Development Division, GCP Standards and Quality Assurance Division, and GCP Solutions Marketplace Division.

Technical Architecture

Section 3 details the technical architecture and corresponding technology environment and specifications of the GCP. The scope of the GCP is to enable data sharing and exchange for the “whole of government.”

It focuses on the various components essential to the GCP’s function as “Platform as a Service” or PaaS to the whole of government.

The general technology environment specifications detailed in this section will apply to the development, staging, and production environments of the GCP.
1 General Systems Description
Section 1 – General Systems Description

The current state of the government’s ICT environment is a patchwork of expensive systems built without the foresight of interconnectivity.

In the effort of respective MIS groups to “deliver” on their commitment to software-enable their processes, most systems were intentionally implemented as a stop-gap to meet the specific objectives of the implementing agency without considering how it would affect the requirements of the whole of government. If we were to liken this to a room in a building, the wall separating it from the rest of the building would be riddled with holes and exposed wiring and plumbing from connections made to the room that were not considered in its initial design.

The amount of after-the-fact independent connections to the different systems of an agency negatively affects the performance of the system and, more importantly, the security of the system – the higher the number of independent nodes, the higher the number of points where failure and security breaches could occur.

The Government Common Platform remedies this by putting order in the system.

Parts that are Wholes, and Wholes that are Parts

Each government entity completely and independently operates as a whole unit; and each, over time, would have developed natural linkages with other agencies with which they formally or casually interoperate or exchange information and data.

These interactions and linkages will naturally give birth to new processes, cultures, and meaning, which simultaneously serve as enablers and inhibitors that would either restrict or introduce new layers of complexity in matters concerning process, data exchange, relevance, and meaning.

The complexity needed to attain interoperability between government agencies becomes apparent when we factor the number of unique elements characteristic to each government agency and government-owned corporations. A relatively simple process such as registration can be highly complicated when we consider all of these variables into a proposed solution.

To reduce the work needed to harmonize differences in areas as simple as registration, most fall into a thinking process that gravitates toward oversimplification. Oversimplification happens when system architects or system designers attempt to enforce a single view of process and meaning on a group of entities that perceive and comprehend the world differently. For us to systemically design a sustainable solution, it is important to embrace the natural complexity that characterizes governmental operations, and use this
reality to define a systems model that will enable us to architect an effective solution specific to government.

The Universe of Government

Viewing the government as a universe of enterprises makes it easier for us to appreciate the impracticality of forcing a single, common model that controls the composition, function, semantics, or mode of interaction between interacting agencies and agencies with the general public. Attempting to do so will be an effort in futility for the simple reason that such a model does not exist in the physical world. What does exist in nature, however, are systems of unique and independent wholes operating seamlessly within the larger whole or systemic universe.

That said, the most practical approach is to factor the co-existence of a multiplicity of methods, functions, processes and standards as a specification of a unified universe of meta-enterprise systems. The unified universe of meta-enterprise systems’ role and function is to set the context and framework on how enterprises within this system would interact and thrive amidst diversity and variety without intruding into the different enterprises that comprise the macro system.

The systems environment of each agency within this unified universe of meta-enterprises are made up of a combination of “conventional” elements such as: Transactional Systems and Data (including financial and regulatory), Administrative Systems and Data, Supply Chain, Logistics and Inventory Systems and Data, Product and Service Catalogue Systems and Data, Shared Services Systems and Data, Non-Structured Systems and Data, Nomenclature Dictionary Systems and Data, Performance Management Systems and Data, Industry and Function Specific Referential Systems and Data, Decision Support and Business Intelligence Systems and Data, Security Management Systems and Data, Workflow Management and Routing Systems and Data, and Central Repository Systems and Data.

These conventional elements could be further granulized into much smaller sub-components (e.g., applications) and so on and so forth – each component functioning as wholes that form part of the greater whole (universe).

Most government entities will have only a few of the listed conventional elements in their respective enterprises. The existence of any combination of conventional elements serves as an indicator of the level of process, technological maturity, and sophistication of each government entity.

The state of deployed systems within each enterprise, driven by the functions and processes unique to each business unit within that government entity, differentiates one entity from another. Each differentiating feature drives the level of complexity of processes, which in turn determines the complexity of effort involved to integrate systems within the intra-enterprise and the extra-enterprise. The more unique the process or function, the
higher the degree of complexity, and the more difficult it is to integrate or interoperate with external entities.

Conventional Functions and Processes

Human resources, financial management, accounting, budget, and procurement, to name a few, are common functions across all government entities. It is in these areas where standardization and interoperability will yield higher levels of efficacy since the processes of each of the underlying functions will vary little between government entities. For example, standard accounting processes are governed by the National Government Accounting Standard (NGAS) and procurement processes by the Procurement Law.

The Context of Standards

System Variety

The closer the affinity of a process to frontline, regulatory, and enforcement services, the more difficult it is to create a standard across the meta-enterprise.

The level of variety increases as the relative proximity of a function or process to frontline public service processes decreases. This is a material fact given that frontline, regulatory, and enforcement services are required to manage transaction level details of interactions with clients with varying levels of need, context, comprehension, culture, worldview, and behavior. This is why the process required to secure medical-related permits is different
from the processes required to secure a driver’s license, a passport, a social security number, a tax identification number, a business registration, or an importation permit.

**The Government Universe of Meta-Enterprises**

Drawing from examples previously cited, we can categorize the services of government entities into three primary categories: *shared*, *unique*, and *interdependent*. Please take note that what we have categorized are not “processes” but “services.”

*Shared* services are the common functions (regardless of organizational context) involving human resources, financial management, etc. *Unique services* are those involving frontline regulatory and enforcement. And *interdependent* services are those that require input from one or more external entities to complete the delivery of the service (e.g., Philippine Business Registry and Philippine Health Information Exchange). Each service category will, by necessity, maintain a set of attributes, data, and information requirements specific or unique to that service category.

These categories are rudimentary to defining the Philippine Government’s interoperability and enterprise service-oriented architecture (SoA) model. The future whole of government enterprise will provision a SoA enterprise as a standard for applications that enable shared service functions, and applications that enable interdependent service functions.

![Figure 2 - Context Diagram of Relationships in the Universe of Government Services](image)

**Shared Service Functions**

The set of shared service functions (*whole of government perspective*) that will be enabled by a centrally-managed enterprise system is essential to reduce unnecessary complexity in designing the meta-enterprise and in managing the future technology environment.

Shared service enterprise applications will *initially* include:
- Identity Management System
- Enterprise Information Portal
- Unified Communications (Email/Instant Messaging/Voice)
- Enterprise Calendar
- Document Management and Archival System
- Human Resource Management and Payroll System
- Accounting and Budget Management System
- Supply and Inventory Management System
- Strategic Sourcing and Procurement System
- Fixed Asset Management System
- Facilities Maintenance Management System
- Logistics and Transport Management System
- Electronic Payment System
- Contracts Management System
- Enterprise Planning
- Project Management System
- Content Management System
- Performance Management System

**Unique Service Functions**

Unique services are those that require the agencies to capture, track, and resolve the *state* and *relevance* of data on case-by-case basis as prescribed by their charters. The lifecycle and the disposition to “share” data or information, given their inherent sensitivity, are determined by the “trustee” agency.

These services include the likes of law enforcement, national defense, national intelligence and security, department of justice, court systems, and so forth. Noticeably, the key characteristic of data generated by these functions is the *level of sensitivity*. They typically fall under the category of “*personally identifiable information*” – which provides deep insight into the private life of a subject or constituent. As such, these types of data, as a rule, are not universally shared even between government agencies.

The parameters for “sharing” and “exchanging” data between agencies entrusted with sensitive data are defined within a legal framework between interacting agencies. It is within this legal framework where the scope of data to be shared, along with the method and timing of sharing or exchange, are explicitly defined.

**Interdependent Service Functions**

Interdependent services refer to functions performed by frontline government agencies that produce a set of data, such as in the case of business name and entity registration, certificates of registration, and issuances of permits and licenses at the national and local levels. Simply put, it involves multiple government agencies sequentially approving the state of data until the data arrives at a completed or final state.
Interdependent functions are a closed-loop process. In this environment, data works its way through a predefined lifecycle – from cradle to grave – until it arrives at a state deemed final or complete.

The tight coupling between data states as determined by interacting agencies means that the effectiveness and efficiencies of the whole are dependent on the efficiency of every component within this closed loop system. Any form of latency or delay that occurs at any given point in the process negatively affects the whole. Faster processes will create congestions against slower processes.

Figure 3 - Data Transformation in an Interdependent Service Environment

Performance latency in the exchange of data is introduced by a myriad of factors that affect the state of data as it hops from agency to agency. Among these are the bit architecture, technology architecture, technology platform, run-time environment, data schema, data types, application-specific proprietary protocols, and security protocols, to name just a few. Latency is certain to occur even if only one of these conditions exists.

A practical and proven way to regulate disparities in data or in processing capabilities between the systems of interacting agencies is to introduce a system "regulator" in the form of an enterprise service bus. This enterprise service bus or ESB is at the heart of a service-oriented architecture environment (see Figure 4).
Government Common Platform Model

The common trap most technical architects fall into is tightly coupling applications with data sharing requirements, and vice versa. Doing so results in rigid and compartmentalized technical designs that are certain to become a future problem.

There is a fundamental distinction between reining in processes by prescribing applications to use and how each of these applications should function. So is providing a core foundation that facilitates the efficient sharing of data and information among interacting agencies regardless of the type or nature of applications.

Controlling application behavior by reining in processes is most suited for enterprise environments where the scope and enforcement of policies and business rules are governed and restricted to a single organization.

An Enterprise Resource Planning (ERP) application, for example, is a clear enabler for managing and controlling intra-enterprise interactions and processes. However, ERP systems can also inhibit extra-enterprise integration since the flow of processes, the definition of policies, the security requirements, and the general behavior of applications within the suite are configured to meet the functional, process, and technical specifications of a single organization. The same condition applies to other enterprise grade applications (e.g. supply chain management, logistics and distribution, etc.), which are configured to meet the functional, process, and technical specifications of a single organization or enterprise.
Design rigidities are best avoided by designing a technical environment based on a Service Oriented Architecture model. A service oriented model, as opposed to other technical architecture models (monolithic architecture, layered architecture, component architecture), allows system architects and developers to de-couple the functional and technical components into logically defined service components by employing an enterprise service bus (Figure 4) to moderate transactional traffic and to support the efficiency, scalability, extensibility, and performance requirements of the enterprise or the government universe of meta-enterprises. By de-coupling applications, service components can independently scale and extend without affecting other components within the technical environment.

An added advantage of employing a service-oriented architecture is that, unlike any of its predecessors, SoA supports agile process alignment by de-coupling governance and policy related aspects from any source environment. This gives the enterprise the flexibility it needs to adapt to the changing policy, functional, and technology environments while inoculating subsystems from effects brought about by changes to any of its component parts.

SOA is not a methodology but a design paradigm. A service oriented architecture or SOA details the “what and how” of systems design, while an implementation methodology details the “how and when” aspects of systems implementation. When referring to a service-oriented architecture, we must remember that this involves a technical design approach.

The challenge confronting the design of an environment conducive to data sharing between agencies across the whole of government is the disparity of systems employed, or the absence of systems in many cases, that need to be factored into the design of the future or target environment.

To build in the requisite flexibility, it is imperative that the design of the envisioned architecture of the future technical environment allows legacy systems as well as “bleeding edge” technologies to co-exist and interoperate. This would best be addressed by employing an Enterprise Service Bus (refer to Figure 4 – Diagram of an Enterprise Service Bus).

The Desired End of the Government Common Platform

The desired end of the Government Common Platform or GCP is to provide a scalable, extensible, and application agnostic platform for government agencies to efficiently share and exchange data or information with each other. The desired end is not so much to dictate or control the type of applications that the various agencies of government will use, but to ensure that essential and mission critical data and information could be efficiently shared between authorized government agencies – regardless of source.

Figure 5 illustrates how government agencies currently share data. This is also applicable to how business units within a single agency share data.
Each agency “node,” as illustrated in Figure 5, is managed independently. The success of data exchanges between source and target nodes in this environment heavily relies on the compatibility between technology platforms and on the management disposition to share or exchange data. This disposition either enables or inhibits data sharing and information exchange.

The current data-sharing environment of government introduces unnecessary complexity in the exchange of data. Because exchanges between sender and receiver are managed on a “per-node” basis, not only does it require additional effort and manpower (technical and functional) to maintain each node, but this current environment also negatively impacts performance and makes technical and policy-related troubleshooting or modifications difficult, complex, and highly prone to error.
The higher the occurrence of error, the higher the latency. And the higher the levels of latency, the lower the perception of users concerning the dependability toward the overall system. Furthermore, maintaining a high number of independent nodes also presents administrators with more potential points of failure, which is something they must strive to minimize.

Figure 6 illustrates the (future) structure that will be employed by the GCP. The structure is intended to reduce management complexity while simultaneously providing the whole of government a way to realize a more scalable, extensible, sustainable, and manageable environment that is conducive to data sharing and exchange.

The scope of the GCP, which is to enable data sharing and exchange for the whole of government, is immense and should be reason enough for us to structure participating agencies into federated collaborative groups that are easier to manage and would be more agile to respond to the changing demands of what data needs to be shared or exchanged between members of the collective.
The Government Common Platform technology environment is organized into two primary domains: client/agency technology environment and the cloud environment. The cloud environment domain, on the other hand, is organized into three managed environments, namely: the collaborative group managed environment, the whole of government registries managed environment, and the intergovernmental enterprise data warehouse managed environment.

- **Client/Agency Managed Environment**
  The client/agency managed environment consists of agency-specific enterprise-grade, client/server, web applications, stand-alone applications, mobile applications, content management systems or portals applications, and business intelligence and analytics systems. These systems could either be on-premise (agency data center maintained) systems or hosted within the government data centers or cloud environment.

- **Collaborative Group Managed Environment**
  The collaborative group managed environment will house its own enterprise service bus\(^1\), MDM system, core applications, data repositories, and data marts for the exclusive use of the collaborative group and its authorized members. It will also house all government shared applications.

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\(^1\) The frequency of Enterprise Service Bus instances are dependent on the service levels and fault-tolerance each ESB instance is defined to provide.
Applications and repositories within this environment will run exclusively on the government cloud platform. For performance requirements, each collaborative group environment will run on its own **collaborative group virtual machine instance** (VMI). The minimum number of VMIs housed in this managed environment will be equal to the number of collaborative groups within the GCP network. Each VMI will contain a pre-configured GCP base technology stack from persistency to presentation.

- **Whole of Government Registries Managed Environment**
  The **whole of government registries managed environment** will house its own enterprise service bus, XSL/XSLT server, and the context registries or clean data repositories accessible to authorized and authenticated users and applications. Data housed in these secured registries will serve as the official, read-only “clean” record for the consumption of the **whole of government**. At the minimum, this environment will house the citizens’ registry, vehicle registry, business registry, and all such registries as may be required by the government.

Repositories within this environment will run exclusively on the government cloud platform. For performance requirements, each context registry environment will run on its own **virtual machine instance** (VMI). The minimum number of VMIs housed in this managed environment will be equal to the number of context registries within the GCP network. Each VMI will contain a pre-configured GCP base technology stack.

- **Inter-Governmental Enterprise Data Warehouse Managed Environment**
  The **inter-governmental enterprise data warehouse managed environment** will house its own enterprise service bus, extract-transform-load (ETL) server and enterprise data warehouse repositories. EDW repositories within this environment will run exclusively on the government cloud platform. To maximize performance and reduce latency, the inter-governmental enterprise data warehouse managed environment will run on multiple clustered virtual machines.
Figure 8 illustrates the different hardware, software, and network tiers and components that make up the systems environment of the GCP. The design of the cloud infrastructure consisting of the network, data center, storage, and business continuity tiers are defined and managed by the Government Data Center team of the Integrated Government Philippines (iGovPhil) project.

The GCP system “sits on top” of the iGovPhil infrastructure as illustrated in Figure 8. There are four system tiers that make up the GCP systems environment: the data management tier, the core system tier, the government shared applications tier, and the unified GCP portal. The data management tier houses all static and transaction databases or repositories and the enterprise data warehouse. The core systems tier houses the enterprise service bus and the application server. The illustration (Figure 8) depicting the “adapters/API” as a single component is for illustration purposes only since the regulating connections to the GCP via an adapter or API is a function integral to the enterprise service bus or ESB. The government shared applications tier will house applications that will be made available and enforced as standard for the whole of government2.

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2 Refer to Figure 16 – Government Common Platform Shared Applications (Page 32)
The **unified GCP Portal**, as indicated by its “unified” label, is the single entry point of users (functional and systems administrators) into the GCP systems environment. “**Portlets**” provide users access to their authorized environments, applications, and features within each application.³

Figure 9 offers an alternative view of the components that make up the GCP systems environment organized into vertical bands. It also includes a master data management (MDM), extraction-transformation-load (ETL) system component, and XSL/XSLT component in the vertical band of data management. It must be noted, that the rules that drive the MDM will reside in the business rules engine of the ESB.

**Virtualized Environment**

Figure illustrates the structure and distribution of the VM environment that will house the GCP systems, and the “access points” into the GCP. Data repositories (transactional and data warehouse) are de-coupled from any application dependency. All transactions and events into the repositories of the GCP will be *regulated* and managed exclusively by the enterprise service bus (ESB).

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³ By using “portlets” the GCP homogenizes the development environment of applications. Given that the GCP is designed to accommodate standard technologies, portlets must support the applications developed using standard programming and scripting languages.
The rationale behind the highly redundant VM structure, particularly at the level of the ESB, is high availability and high fault tolerance. While each ESB instance could theoretically support \( n \) numbers of applications, because the GCP environment will support the whole of government, limiting the number of ESB instances (while less expensive) also means that in the event of a failure, all applications that depend on that failed instance will also fail. Limiting the number of ESB instances, in this kind of environment, increases administration and management complexity.

**High Availability and Process Agility**

Unlike other "enterprise" systems that could tolerate "downtime" as system usage is typically at its lowest on non-working days, the GCP cannot afford such a luxury – it cannot go down as a whole as it needs to be available 24 x 7 x 365.

Not only must the GCP maintain higher than normal service levels, it must also allow application-level functionality to undergo changes without having to "down" any of its component parts, and allow changes to be rolled out from staging to production at runtime (see Figure 1).
Customization that requires modifications at the code level will only be performed in their respective development environments. Since the staging environment is an exact replica of the production environment (just smaller in size), only those applications that are ready for testing will be allowed into the staging environment.

**User Access**
End users (public users, administrators, and functional users) will access the GCP exclusively via the unified portal. As mentioned earlier, portlets provide users access to their respective environments for which they are authorized to use.

**Security and Administration**
Roles and permissions to specific instances will be centrally managed by GCP system administrators, while environment administrators will manage all roles and security permissions at the level of their environments for which they have been granted administrator privileges. The *Public Key Infrastructure* (PKI) subsystem will be integral to the security environment of the GCP. PKI tokens will be required to authenticate all users and their activities in areas of the GCP where a user login is required.
The centralized administration of the GCP systems environment provides for four levels of administration, each with defined administrator-level roles and privileges to enable compartmentalization essential to maintaining security levels. These levels are: GCP Master Administrator, Environment Administrator, Database Administrator, and Application Administrator. Rights and privileges would have to be made explicit to allow any of the different administrator roles access to other layers of the system.

The GCP Master Administrator, while having top-level access privileges to the environment, will not have access to lower levels by default. Environment Administrator privileges would be limited to the GCP core system components (see Figure 8). Database Administrator privileges would be limited to the database tier, while Application Administrator privileges would be limited to specific applications. Because of the sheer magnitude and scope of the GCP, no administrator privileges with far reaching authority will be granted to a single individual.

**Capacity and Performance**

The sustained performance of any system is the litmus test of any architecture. Because of the “whole of government” scope that the GCP will need to support, utilization thresholds would have to be made a little more conservative than global standards. This conservatism is important as no extant data on system performance is available – it only takes one outage to create a perception of unreliability for any system.

The report\(^4\) published on the top-10 servers tested by the Transaction Processing Council that measured transactions per second throughput of an IBM System x 3850 X6 server\(^5\)

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\(^5\) CPU: Intel Xeon Processor E7 – 4890 v2 2.80 GHz (15 cores per processor)
currently in the market, demonstrated a transaction per second (tpsE) throughput capacity of 5,576.27 transactions per second.\textsuperscript{6}

To ensure that the GCP environment will have sufficient capacity to service the whole of government, we have initially specified that the GCP system must be able to handle 50,000 transactions per minute. To compute for the size of the server environment, we will use the estimates in the table below to form our baseline capacity and performance sizing requirements.

\textit{Table Error! No sequence specified. - Estimated Baseline Values (Imputed)}

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</tbody>
</table>

Using a \textit{sample} model consisting of three groups (Core, Business, and Transport)\textsuperscript{7}, the GCP will need to immediately provide capacity to handle 50,200 read-write transactions per minute at the bare minimum (an average of 8,858 transactions per application per minute).

\textit{Table 2 - Sample GCP Systems Environment Capacity Requirements}\textsuperscript{8}

<table>
<thead>
<tr>
<th>Group</th>
<th>Virtual Machine</th>
<th>Est. Transactions / Minute</th>
<th>Target Threads / Minute</th>
<th>Cores</th>
<th>Processors</th>
<th>RAM (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core System</td>
<td>4</td>
<td>7,000.00</td>
<td>58</td>
<td>29</td>
<td>2</td>
<td>128.00</td>
</tr>
<tr>
<td>Business</td>
<td>6</td>
<td>11,200.00</td>
<td>93</td>
<td>47</td>
<td>4</td>
<td>128.00</td>
</tr>
<tr>
<td>Transportation</td>
<td>17</td>
<td>32,000.00</td>
<td>267</td>
<td>133</td>
<td>9</td>
<td>256.00</td>
</tr>
<tr>
<td><strong>Total Capacity</strong></td>
<td>26</td>
<td>50,200.00</td>
<td>418</td>
<td>209</td>
<td>15</td>
<td>512.00</td>
</tr>
</tbody>
</table>

If these values are inclusive of peak periods, the actual number of cores, processors, and amount of RAM relative to the number of transactions per minute should only represent 20 percent of full utilization at peak since it is advisable to build in 80 percent overcapacity to prepare for peak periods.

The percentage of overcapacity can be reduced after GCP system administrators have had the chance to sufficiently measure standard performance deviations from actual production over a predetermined period of time.

\textsuperscript{6} To view the specifics of the performance test, visit: http://www.tpc.org/tpce/results/tpce_perf_results.asp?id=114021601
\textsuperscript{7} Transaction volumes are estimated values only.
\textsuperscript{8} 15:1 cores/processor. Each thread handles 46.47 transactions (\textit{estimated}). Number of cores, processor, and amount of RAM is an aggregate of the total environment of virtual machines. The “core system” represents a small subset of the planned Government Shared Applications.
Factoring an 80 percent contingency over peak processing capacity\(^9\), the resulting values will be as follows:

*Table 3 - GCP Systems Environment at 80% over capacity*

<table>
<thead>
<tr>
<th>Group</th>
<th>Virtual Machine</th>
<th>Est. Transactions / Minute</th>
<th>Target Threads / Minute</th>
<th>Cores</th>
<th>Processors</th>
<th>RAM (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core System</td>
<td>4</td>
<td>12,600.00</td>
<td>105.0</td>
<td>53</td>
<td>4</td>
<td>230</td>
</tr>
<tr>
<td>Business</td>
<td>6</td>
<td>20,160.00</td>
<td>168.0</td>
<td>84</td>
<td>6</td>
<td>230</td>
</tr>
<tr>
<td>Transportation</td>
<td>17</td>
<td>57,600.00</td>
<td>480.0</td>
<td>240</td>
<td>16</td>
<td>461</td>
</tr>
<tr>
<td>Total Capacity</td>
<td>26</td>
<td>90,360.00</td>
<td>753.00</td>
<td>377</td>
<td>25</td>
<td>922</td>
</tr>
</tbody>
</table>

System administrators must note that most enterprise-grade systems (applications and databases) block off or “reserve” large chunks of available disk swap space (virtual memory) and RAM for its services. Reservation values are configured by default upon installation and in most cases, tinkering to reduce these values in an application server or database server will severely impact the performance of the system and all subsystems that depend on it. This makes it more important to plan and build overcapacity to reduce potential latency.

**Collaborative Groups of the Government Common Platform**

Making data contextually relevant requires us to logically design collaborative relationships that allow meaningful and valuable sharing or exchanges to be more explicitly defined.

The objective is to be explicit on the scope of what data will be shared (or even valuable for sharing) in order to eliminate unnecessary “noise” that renders data incomprehensible if not completely useless to service consumers – human or machine. The goal is to institutionalize an environment where technology solutions consistently and progressively enable real-world conditions.

\(^9\)These values are exclusive of a redundant, fault-tolerant environment.
While the idea of dumping all forms and types of data into a gargantuan repository or data warehouse might sound appealing to those who desire to achieve a quick win or “solution,” the resulting environment will introduce layers of compounded complexity that traverses the vertical and horizontal dimensions of the future technical solution stack.

Universally relevant data, or data that is usable or valuable to the entire meta-universe of government, is really data about natural persons. This will include data about personal relationships, participation in juridical entities, economic activities, legal and financial transactions, education, work and employment, travels, privileges and benefits, and the purchases of assets and real properties, and so forth, of natural persons (see Figure 3). These categories allow data and information managers to build a picture about natural persons. These categories are also key points of interests that collaborative groups could build relevant content from.

To enable the structure of collaborative groups for data sharing, it is important to qualify the scope of data that will be universally shared from data that will only be shared among a handful of agencies, or even divisions within an agency.

When it comes to effectively defining the scope of data that needs to be shared, the key is to “explicitly detail” all data elements that will need to be shared. Generalizations (usually
PHILIPPINE GOVERNMENT COMMON PLATFORM

consisting of a predefined set of data elements) are not particularly useful when sharing with external entities since the meaning of such generalizations will differ by entity.

In order to have complete meaningful and usable information, data elements shown in Figure would have to be associated with data elements beyond those associated to data supersets. Supersets and subsets of data will result from the aggregation of associated or common data elements, which in turn become the basis for defining metadata and metadata elements.

These contextual data illustrated in Figure serves as the foundation for organizing agencies into explicitly defined collaborative groups. By analogy, the envisioned structure takes after fractals or holons – images similar but smaller, each being functional wholes and joined to form the greater whole or “big picture” – the big picture being any macro context defined by GCP or the collaborative group.

Members of a collaborative group can be contributors or consumers of data or both, depending on their immediate contexts. Organizing interacting agencies into smaller, agile collaborative groups will prevent groups from drowning in their own data by limiting the volume of data that is contributed or consumed to a controlled, explicitly defined context.

List of Prospective Collaborative Groups
Based on a review of the various contexts of data sharing between government agencies and government-owned and -controlled corporations, collaborative groups were defined.

The list of collaborative groups serves only as an initial structure. The structure will naturally evolve and change over time as the scope of each group is more explicitly defined and groups spawn additional context groups, as they will likely do, in the process of producing relevant and usable information.

Because collaborative groups are context driven (see Figure and Figure ), the ecology of standards advocated in the Philippine e-Government Interoperability Framework (PeGIF) becomes executable, particularly in areas related to data, process, and governance.

Organizing the “whole of government” into collaborative groups also allows program managers to develop a realistic implementation schedule toward a progressive and systematic conversion of the more than 300 agencies of government into the fold of the GCP network.
The Elements of a Collaborative Group

A collaborative group is made up of the following elements: a defined set of member agencies organized to fulfill a specific scope, guided by a clear set of standards in governance (policies, processes, and procedures) with an explicit set of specifications defined for data sharing and data exchange, and a set of clearly defined shared applications.

Membership

Membership in a collaborative group will largely be determined by the scope of the collaboration, which will be based on the need for sharing and exchange. Most government agencies operate in silos with little to no ability to share data with external agencies (or even internal units within their respective organizations). Unless an agency has the funds and operational capability to maintain up-to-date information, it is likely that the data that is now stored in its repository or website (which is intended for both internal and external consumption) is not regularly updated (as this would require a significant amount of human intervention to update data).

By joining a collaborative group, agencies that do not otherwise have the financial capability or operational bandwidth to secure updated data stand to benefit by being able to share data from members with updated data. Likewise, by joining the collective, larger and more capable agencies could exponentially grow internal capabilities and knowledge bases by being able to access and cross-reference information from multiple agencies operating within a context similar to theirs.
**Group Membership Classification**

Collaborative group membership will be classified into the following: *essential, enabling,* and *supplemental.*

*Essential members* are those whose scope of operations is directly related to the objective scope and function of the collaborative group.

*Enabling members* are those whose scope of operations is not necessarily related to the objective scope or function of the group but whose function enables the effectiveness of the group (i.e., Information and Communications Technology Office, operations research, industry participants, consultants and field specialists, etc.).

*Supplemental members* are those whose scope of operations provide supplemental value to the objective scope of the group (e.g., congressional committees and presidential commissions) but whose participation remains optional.

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**Governance Standards**

![Governance Model](image)

*Figure 15 - Governance Model*
It is impractical for those who are too far removed from the tactical level to explicitly define which data elements are allowed to be shared among external agencies. In the same way, enforcing and managing governance models at levels too far removed from where transactions occur is difficult if not impossible to execute.

Rather than attempt to define and enforce governance models at the high level, the best place to do so would be at the level of the collaborative group. The agile structure of a collaborative group allows it to organize and manage a more effective steering committee composed of tactical managers who are more intimately familiar with the their agency’s data structures and the interoperability needs among members of the collaborative.

Because of its relatively smaller size, the collaborative group can move quicker to resolve issues as long as the members of the group, who represent respective agencies, are empowered to make decisions on behalf of their agency within the scope of the group membership.

Advocating a set of standard policies that affects or intrudes on the policy environments of different agencies will prove complicated and difficult to execute. By reducing the extent of reach of policies that traverse political and organizational boundaries and limiting these to the point or level of interaction at the collaborative group level, the complexity of managing the scope will be minimized, making for a more conducive and sustainable data exchange environment.

Figure illustrates the governance model at the level of the collaborative group. A collaborative group steering committee will be organized to define and enforce standard processes, policies, procedures, security privileges, sharing protocols, and interoperability requirements based on the Philippine eGovernment Interoperability Framework (PeGIF) standards.

Under this governance model, members of the steering committee, who represent the different agencies that form the collective, will each be responsible for escalating and resolving issues, securing the necessary approvals from their respective executives, if and when such approvals are required.

**Data Sharing and Exchange Standards**

Since determining how agencies will share and exchange data is the first step to creating value for the GCP, collaborative groups will be in a better position to explicitly define what data elements will be shared between interacting agencies.

This approach prioritizes the desired end of the GCP – data sharing. The more explicitly data elements for sharing are defined, the less the need for any one agency to comb through complex data structures (noise) of their internal applications just to hunt for pertinent data elements to share; and the more valuable the GCP network of collaborative groups becomes to the whole of government.
The GCP’s desired end to allow *the whole of government* to share data is more than just managing or meeting technical service levels, or the ability to process and transmit high volumes of data across an interconnected Wide Area Network. More importantly, it is about ensuring that the quality of data shared via the GCP is auditable, credible, and up to date.

Data exchanges between interacting agencies within a collective will be in either structured (SQL-based) or non-structured (non-SQL-based) formats, or both, depending on the need and technical context. Building in the requisite flexibility to enable members of a collective to share both structured and non-structured data not only allows backward compatibility, but more importantly, also sets the foundation for a future-proof, extensible environment.

**Shared Applications**

![Figure 16 - Government Common Platform Shared Applications](image)

Shared applications accessible via the GCP are grouped into two environment categories: *personnel self-service applications* and *shared enterprise applications*.

The category of applications domiciled within the GCP as illustrated in Figure are intended to address information requirements at both the individual and organizational level; thus, creating a closed loop environment that captures data at the atomic (personnel) level of the organization and allows more efficient cross-referencing between actual behavior and pro-forma processes.

**Personnel Self-Service Application Environment**

These consist of a set of applications for government employees to access standard productivity tools (such as Email and Calendar), view and update personal information
(such as Payroll and Benefits), transact with other departments within their organization, and perform individual transactions directly with other government agencies (such as the GSIS, BIR, CSC, PHIC, etc.) through GCP application portlets.

**Shared Enterprise Applications**

These consist of a set of applications guided by a common government standard (such as those involving accounting, budget management, finance, treasury, etc.) and applications commonly used by government agencies such as contract management, project management, and document approval routing. It will also provide content portlets that will house government content intended for universal consumption.

**The Value of Collaborative Groups**

In his presentation on the Economics of Networks to the US Department of Homeland Security, Director Rod Beckstrom of the National Cybersecurity Center presented his *network valuation model.*

Beckstrom defines the network valuation model as follows:

> “The value of a network equals the net value added to each user’s transactions conducted through that network, summed for all users.”

Alternatively, Beckstrom provides an equivalent definition from the vantage of the user:

> “The value of a network equals the value added to all transactions conducted on that network, valued from the standpoint of each user.”

Applying Beckstrom’s concept to the Government Common Platform network, it is easy to see how data that is defined, aggregated, and processed through a series of disaggregation, correlations, and re-aggregation by a collaborative group in the GCP network will increase the perceived value of data from the standpoint of each member of that collaborative group. The value of this data also increases as collaborative groups develop expanded relationships with other collaborative groups within the network. Furthermore, the aggregate cost of processing data to produce meaningful information will be a fraction of what a single agency would have to spend in order to produce the similar results.

The cost of managing an environment (if a single agency were to develop a complete and up-to-date profile on its own) of natural persons in the country, on elements illustrated in Figure and Figure, are beyond what any agency could financially justify and operationally support since no agency would have the financial means, the need, or authority to capture all of these data elements (or variables) that provide a comprehensive view of natural persons.

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10 Beckstrom, Rod, Presentation: *Economics of Networks*, National Cybersecurity Center, Department of Homeland Security (December 12, 2008).
By having collaborative groups focus on key data areas and by providing them with an enabling platform to share meaningful information (not just raw data), agencies, through their collaborative groups, can afford access to updated information unavailable to them in the past. It must be noted that as the cost of securing meaningful information goes down, the quality of data shared by and between agencies within the GCP network will improve over time.

Each collaborative group within the GCP network (see Figure ) serves an important reinforcing role in increasing the value or valuation of data and information exchanged among members of a collaborative group, and among collaborative groups within the GCP network. In fact, explicit value would already be realized by simply reducing the cost required for agencies in the GCP network to access quality and credible data essential to improve their operational effectiveness and enhance their ability to source information for use in decision making processes.

We cannot overemphasize the importance of producing meaningful information through the GCP network.

Meaningful information entails providing near accurate and up-to-date information, using data sourced from agencies (or in this case, from the repository of collaborative groups) having the closest proximity to the transactions or activities of a natural person, on the following basic scenarios:

- That taxpayers declared the correct income and value of assets in relation to taxes that were paid.
- That taxpayers could directly check on their transactions with the BIR, and have the ability to electronically file and pay their taxes without the need to physically visit a BIR office.

- That business owners can electronically complete the registration and payment of business registrations with respective agencies (e.g., DTI, SEC, and CDA) without having to visit any physical office.

- That a business registered with the Philippine Business Registry only needs to provide an LGU with its registered Tax Identification Number (TIN) to register or renew a business in that city or municipality.

- That a landowner could directly secure patents or information on patents electronically from the Land Registration Authority or Registry of Deeds.

- That employees (private or government) could directly check with the SSS or GSIS the status of their contributions.

- That a business operating in a locality has the required licenses and certifications to operate and handle restricted materials.

- That the Bureau of Fire Protection has access to building floor plans in case of a fire alert, a calamity, or a disaster (natural or man-made), and in such a scenario pre-notify local police, emergency medical services, and traffic enforcers to immediately halt or re-route traffic flows to give way to emergency vehicles.

- That businesses have direct access to an updated library of requirements and pertinent laws to help them comply with the legal requirements to operate.

- That a person arriving from an international flight determined to be a carrier of some form of dangerous contagion could be immediately located.

- That a citizen requiring medical treatment could be admitted into a hospital providing only the citizen's full name to get the full benefits from the Philippine Health Insurance Corporation (PHIC).

- That a drug administered in a hospital or sold at a pharmaceutical has the necessary permits from the Food and Drug Administration (FDA).

- That enforcers and buyers could directly check the status of a vehicle's (land, sea, or air) registration and the trail of ownership (for buyers).

- That commuters could be immediately notified or systematically re-routed to secondary routes in cases of vehicular accidents, road constructions, police activity, or special events.
That law enforcers could immediately receive a flash bulletin containing a photo of a criminal perpetrator within minutes of the commission of a crime with instructions on probable exit points that would be taken so that dragnets could immediately be mobilized.

That the cargo manifest of a container or shipment entering the country is authentic and accurately matches the items the shippers declared to be carrying from the port of origin.

That a citizen living or working in a foreign country can be contacted, located, and repatriated in cases of emergencies (such as a natural disaster, civil unrest, or war).

That the Bureau of Immigration and local law enforcement can interdict a foreign national entering the country who is flagged as a threat to national security.

If the GCP could allow members of collaborative groups to have access to relevant information that addresses the scenarios cited above on-demand, then the benefits derived from achieving this level of efficiency will produce a disproportionately higher value. This higher value will rationalize the required financial investments to establish, manage, and sustain such a collaborative environment. Given the above, it is no longer a question of whether or not the government could afford to implement the GCP, but whether the government can afford not to implement the GCP.

Value Flows: From Raw Data to Meaningful Information

Figure 18 - Generating Meaningful Information through Collaborative Groups
Figure illustrates how data, transformed into contextual information, flows through the network of collaborative groups, transforms into meaningful information, and distributed to respective collaborative repositories and contextual registries shared with the whole of government.

Figure provides a comparative illustration between the structure and flows of data sharing at present and in the future. The data sharing structure on the left illustrates the current circuitous and chaotic environment of government where individual agencies need to build direct interfaces to several external systems to source sufficient data, which they in turn could use to build reports. The credibility of the agency's information will be affected as point nodes get disconnected or data from any of those source interfaces gets corrupted. In this scenario, no buffers or additional points of correlation exists to check the veracity of any parcel of data.

Unlike the structure on the left, the future structure (right) regulates the quality of data by coursing it through multiple stages of aggregation and validation (human and machine) before any piece of data is shared with the rest of government via respective collaborative repositories and contextual registries.

It is one thing to simply source data and quite another to source credible data. This capability of providing credible data is a key differentiator of the GCP. Rather than have agencies maintain direct independently managed connections to other agencies, they would simply connect to the GCP.

By virtue of its structure, the GCP network can and will provide more credible information than a single agency could because of its ability to validate, process, and aggregate massive amounts of data into information packages sourced from the different collaborative groups.
Data to Information: Transformation Process

The cycle of transforming raw data into meaningful information is an iterative, recursive, and closed loop process involving human and machine interactions and consisting of six stages of progressive activities: generate, codify, apply, manage, integrate, and renew.

Each stage of activity, as illustrated in

Figure 2, consists of requisite activities that each generate as specific salient benefit and plays an integral role in the transformation process. The requisite activities of each stage are integral to the transformation process performed by collaborative groups in the GCP network against every parcel of data it validates, processes, and aggregates.

Figure 2 Error! No sequence specified. is an alternative way of viewing this transformation process as a cycle of continual improvement from the point when data is generated, then transformed to information, knowledge, meaning, philosophy, wisdom and back again. As illustrated in

Figure 2 Error! No sequence specified., these stages of transformation occur at the point where activity stages, focus, and salient benefits intersect, bound together at the core by a unifying activity.

Transformation is not a direct output beyond “information” as subsequent transformations occur at the human level where additional variables and conditions (such as worldview, presuppositions, culture, language, education, norms and values, work context, etc.) affect the transformation process. It is also only at the human level where “union” is achieved.

What could be codified into a database are the imputed “meanings” that a person arrives at through the transformation process.
The structure of collaborative groups allows a more efficient transformation process, and that same structure regulates and reduces the compartmentalized imputation of meaning since multiple persons coming from a variety of backgrounds, professional contexts, and perspectives are intimately involved in the formulation of “meaning.”

*Figure 2: Transformation Process (Cycle View)*
2 Change Management Strategy
Section 2 – Change Management Strategy

Section Overview

This section discusses the elements of change environment as the GCP is implemented, how to adapt to changes and how to manage them. Discussion includes the philosophy behind change like the setting of desired end, the change processes necessary to achieve the desired end, sustaining the positive changes, sharing the benefits, and acquiring the correct attitudes to improve the system.

As stated earlier, the change management strategy for GCP is to invest sufficient resources and attention to the behavioral elements. For this, knowledge workers must be employed, as the job requires a shift in mindset, systems, and methods.

The Environment of Change

Managing the change process is indispensable when implementing large-scale systems or technology projects. The change process consists of hard and soft system components. *Hard systems* pertain to the engineering or technology components of the project, while *soft systems* pertain to the behavioral components of the project. The behavioral component is made up of subcomponents or variables that are influenced and/or driven by options and choices; as such it is the more complex of the two. This distinction is particularly amplified in software projects where the desired end is to compel machines to mimic human behavior.

The environment of change is constantly in a state of flux where a single action triggers multiple events with the potential of altering the state of a component (or multiple components) either temporarily or permanently. This potential is characteristic of what happens in large-scale projects, where a substantial number of active parts are moving simultaneously but not necessarily in the same direction.

The objective of a change management strategy is to regulate the movement, direction, and results of activities so that all the different parts of a project move toward achieving the desired end of the project.

Change management is a continual cycle that reinforces either positive or negative behavior and produces either constructive or destructive outcomes. The outcome depends on the prevailing environment of change.
The Change Management Cycle

Figure illustrates the change management cycle as a set of intersecting ellipses representing definition, acculturation, re-habituation, and publication. Each ellipse represents its own unique process lifecycle.

The intersections between ellipses represent the activity focus (see Table). For example, the activity focus from definition to acculturation is rationalize, from acculturation to re-habituation is replace, from re-habituation to publication is reinforce, and from publication to definition again is re-evaluate. The outcome of re-evaluation serves as inputs to definition, which then triggers a new cycle of change.

Table 4 - Activity Focus (per Change Cycle Component)

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>ACTIVITY FOCUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition (What is my desired end?)</td>
<td>Rationalize</td>
</tr>
<tr>
<td>Acculturation (How do I change?)</td>
<td>Replace</td>
</tr>
<tr>
<td>Re-habituation (How do I sustain these changes?)</td>
<td>Reinforce</td>
</tr>
<tr>
<td>Publication (What benefits of change do I share?)</td>
<td>Re-evaluate</td>
</tr>
<tr>
<td>Measure (How do I make it better?)</td>
<td>Innovate</td>
</tr>
</tbody>
</table>

The measure ellipse in Figure is the only component that intersects all four ellipses and because measurement is integral to every component, it is where potential areas of innovation could more likely be identified.
Definition Change Process Component

The process component of definition evaluates the question, “What is my desired end?” The definition process begins at the conceptualization stage of a project and is often rationalized by a business or operational pain. The scope of the definition process is to make the future environment explicit by addressing business pain not in isolation but as a systemic whole. As a function of change, the definition process involves the following activities:

1. Elicitation (of the areas of pain)
2. Diagnosis (of the systemic condition)
3. Prescription (of the desired future state)
4. Visioning and Design (of the desired end)
5. Planning (of the roadmap to achieve the desired end)

Acculturation Change Process Component

The process component of acculturation evaluates the question, “How do I change?” To change the way we behave, we must first change the way we think. The acculturation process granulizes specific strategies on how to achieve specific objectives detailed from the definition process. The scope of acculturation involves mindset formation activities designed to “replace” existing behavior with those consistent with the desired end of the project but applicable at the level of individual participation (How do I change?).

It is important to note that the activity focus is to replace and not to eradicate. Acculturation is a series of processes of substitution not eradication. The acculturation process enjoins members of a collective to commit to specific areas of change essential to achieving the prescribed future state of the initiative or project and involves the following activities:

1. Behavioral Assessment
2. Systems Methodology Development
3. Structured Communication and Education
4. Benchmarking and Measurement

Re-habituation Change Process Component

The process component of re-habituation evaluates the question: “How do I sustain these changes?” The re-habituation process involves activities that reinforce the committed areas of change as detailed in the acculturation process. This involves conditioning activities to systemically reinforce change essential to achieving the desired end of the initiative or project.

The re-habituation process involves the following activities:

1. Intervention Planning

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11 To design an effective communication and education campaign, refer to the section Human Learning in the Transformation Process (Page 46) for areas to consider in relation to human learning processes.
2. Training and Development
3. Renewal and Continual Improvement
4. Benchmarking and Measurement

Publication Change Process Component

The process component of *publication* evaluates the question, “What benefits of change do I share?” The form of *publication* will depend on the preference of the target consumer. The activity focus of the publication process is to *re-evaluate* activities and outcomes by aggregating learning from the different processes in the change cycle and to transform the same into a structure of “shared understanding” conducive to individual learning and continual improvement.

Implementing Change Management

The different change management process components detailed above are not to be implemented as a separate project but are to be executed as integral to the activities of the main project. The components of definition, acculturation, re-habituation, and publication must be integrated at the activity level if the project is to achieve its desired end.

Integrating change management processes at the activity level is important as it targets the behavioral elements of a project. A project is composed of 15 percent structural (material) and 85 percent behavioral (people-related) components. It means that the delivery of structural components contributes only 15 percent to the success of a project. It must be noted that the objective here is not to use the 85 percent as a basis for designing the 15 percent, but to lead the 85 percent to adopt the structure of the 15 percent.

In the context of the Government Common Platform, the technology components, regardless of sophistication, will only be 15 percent part of the solution. It is important to dedicate and invest sufficient resources and attention to the behavioral elements if we are to achieve the desired end of the GCP. In the final analysis, the material (technology) elements are tools that derive their *value from the standpoint of those who use them*. The goal of any change management strategy is to achieve behavioral assimilation (or what is commonly referred to as buy-in) reinforced by competency.

Managing Behavioral Change

Knowledge workers are at the heart of the successful *delivery* of a project. Knowledge workers are also important in *sustaining* the progress of the program after it has been successfully delivered. For an organization to continually and progressively evolve, it is important to employ a systemic method of managing behavioral change by focusing on the dynamics that enable or inhibit productivity among knowledge workers or a collaboration of knowledge workers.

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12 *Beckstrom’s Law* (refer to The Value of Collaborative Groups, Page 3333).
Figure illustrates the dynamic environment of managing knowledge workers and the systems that enable or inhibit the desired end. It is noticeable that “motivation” in the context of Figure does not demonstrate a bias toward a positive or negative outcome (since both positive and negative inputs are sufficient motivators) but simply illustrate the interactions between the work environment, personal mindset, perceptions, systems, and scenarios that influence a “motivated” knowledge worker.

![Diagram of managing knowledge workers](image)

**Figure 23 - Managing Knowledge Workers**

Without going into an organizational diagnosis of how government currently manages its knowledge workers, it is sufficient for now that we realize that the GCP is “new wine” and if we attempt to put new wine in old wineskins, old wineskins will rupture. As such, it requires that a shift in mindset, systems, and methods occur so that these could sufficiently contain the “new wine” that is the Government Common Platform.

**Human Learning in the Transformation Process**

Table provides a tabular view on how human learning and the creation of new knowledge – steps that are essential to the creation of meaningful information within the GCP network – are related and integral to the transformation process.
<table>
<thead>
<tr>
<th>Knowledge and Learning</th>
<th>Action and Performance Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>DATA</td>
<td>Action: GENERATE</td>
</tr>
<tr>
<td>Learning: Instinctual Level – past experience (wisdom) plays a significant role in the data mode of learning. However, at this level little actual learning takes place.</td>
<td>Focus: Feedback - Generating or gathering information. Receive input and register data without reflection.</td>
</tr>
<tr>
<td>Orientation: Immediate Moment</td>
<td>Perception: Awareness</td>
</tr>
<tr>
<td>INFORMATION</td>
<td>Action: CODIFY</td>
</tr>
<tr>
<td>Learning: Single-Loop – Entails action without reflection. Procedures are codified to re-direct action toward a predetermined course. Learning is mostly trial and error.</td>
<td>Focus: Efficiency - Codification is action intended to increase efficiency through standardization. The focus is on developing efficiency through codification of procedures.</td>
</tr>
<tr>
<td>Orientation: Now / Present (very short)</td>
<td>Perception: Physical Sentience (sensation without reflection)</td>
</tr>
<tr>
<td>KNOWLEDGE</td>
<td>Action: APPLY</td>
</tr>
<tr>
<td>Learning: Double-Loop. Self-conscious reflection. A larger perspective that involves evaluation and modification of the goal or objective as well as the design of the path or procedures on how to achieve the goal. Learning requires self-conscious reflection.</td>
<td>Focus: Effectiveness – focus is doing it the best way. Effectiveness is determined by choosing between two or several alternative paths with the goal being effective action and the resolution of inconsistencies. Focus is on effective work design, engineering aspects, such as process redesign.</td>
</tr>
<tr>
<td>Orientation: Past and Present (short)</td>
<td>Perception: Reflective</td>
</tr>
<tr>
<td>MEANING</td>
<td>Action: MANAGING</td>
</tr>
<tr>
<td>Learning: Communal. Understanding context, relationships, and trends. This level involves the making of meaning, which includes understanding context, identifying trends, and generating alternatives based on the aforementioned. Moreover, it is at this level where relationships between components or functions are detected, mapped, and comprehended.</td>
<td>Focus: Productivity – the focus is on understanding key enablers and inhibitors. This involves effective management and allocation of resources and assignment of tasks using a conceptual framework (to bridge the visionary ideals of management with the chaotic reality of the front-line business) to analyze and track multiple variables.</td>
</tr>
<tr>
<td>Orientation: Historic past, present, and very near future (medium to long)</td>
<td>Perception: Community</td>
</tr>
<tr>
<td>PHILOSOPHY</td>
<td>Action: INTEGRATING</td>
</tr>
<tr>
<td>Learning: Duetero (Combining). Self-Organizing. Seeks to understand dynamic relationships and non-linear processes. Also involves the discernment of patterns that connect, and requires the understanding of embeddedness and the interdependence of systems.</td>
<td>Focus: Optimization – seeing where each activity fits the big picture and managing the socio-cultural system dynamics. Focus is on long-term planning and the ability to adapt to changing environments. Comprises long-range forecasting and the development of multi-level strategies.</td>
</tr>
</tbody>
</table>
## Knowledge and Learning

<table>
<thead>
<tr>
<th>Orientation: Past, Present, and Future (Long-Term)</th>
<th>Action and Performance Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wisdom</strong></td>
<td><strong>Action: RENEWING</strong></td>
</tr>
<tr>
<td>Perception: Pattern</td>
<td>Focus: Validate Integrity. Finding or reconnecting with values, vision, and mission. Also involves an endeavor to deeply understand purpose through the exercise and utilization of metaskills. Very long timeframe leads to deep awareness of ecology, community, and ethical action.</td>
</tr>
<tr>
<td>Learning: Generative. Learning for the joy of learning. This involves creative processes, heuristic, open-ended explorations, and profound self-questioning. This level allows for the discovery of one's highest capabilities and talents, purpose and intentions.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Orientation: Very distant past to very distant future (Very Long-Term)</th>
<th><strong>Action: UNION</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Union</strong></td>
<td>Focus: Understanding values in greater context. The inter-generational orientation evokes commitment to the greater good of society, the environment and the planet. One’s performance is demonstrated by actions consistent with these deeper values.</td>
</tr>
<tr>
<td>Perception: Ethical</td>
<td></td>
</tr>
<tr>
<td>Learning: Synergistic. Learning at this level seeks to integrate direct experience and appreciation of oneness with nature, the environment and the greater cosmos. Requires processes that integrate purpose to the health and well-being of the larger community.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Orientation: Inter-generational, timeless</th>
<th>Perception: Universal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table serves as a guide to help program managers, organizational designers, process analysts, and systems designers map out design elements and change management strategies that align with the way human beings learn, create meaningful information, or create new knowledge. It will also help collaborative groups design processes that will make data generation, validation, processing, and aggregation more efficient and sustainable for the long term.

## The Future Organization of the Government Common Platform

The structure and composition of the future GCP Office (GCPO) is as important as the technology products and services it will offer to the whole of government. The future GCPO will be a division of the Information and Communication Technology Office (ICT Office) of the Department of Science of Technology (DOST). The GCPO will be lean in terms of structure, composed of highly-skilled and knowledgeable technology professionals.
The GCPO will be organized into a management group composed of five initial divisions, which shall directly report to the ICTO Executive Director. These divisions are as follows:

- The GCP Production Systems Division;
- The GCP Project Management Division;
- The GCP Systems Development Division;
- The GCP Standards and Quality Assurance Division; and,
- The GCP Solutions Marketplace Division

**The GCP Production Systems Management Division**

Figure 24 - The GCP Management Group

Figure 25 - The GCP Production Systems Management Division
The GCP Systems Development Management Division

The GCP Project Management Service Division

Figure 26 - The GCP Systems Development Management Division

Figure 27 - The GCP Project Management Services Division
The GCP Standards and Quality Assurance Management Division

Figure 28 - The GCP Standards and Quality Assurance Management Division

The GCP Solutions Marketplace Management Division

Figure 29 - The GCP Marketplace Management Division
3 Technical Architecture
Section 3 – Technical Architecture

Section Overview

This section details the technical architecture and corresponding technology environment and specifications of the Government Common Platform. The scope of the GCP is to enable data sharing and exchange for the “whole of government.”

![Figure 30 - GCP Technical Environment](image)

General Technology Environment Specifications

The technology services of the iGovPhil project will be tiered into the following offerings:

- *Infrastructure as a Service (IaaS)* – the iGovPhil Cloud Infrastructure
- *Platform as a Service (PaaS)* – the Government Common Platform
- *Software as a Service (SaaS)* – the Government Shared Applications
- *Database as a Service (DBaaS)* – the enterprise no-SQL database system

This section details the various components essential to deploying the GCP’s “Platform as a Service” offering (see Figure ).
The general technology environment specifications detailed in this section will apply to the development, staging, and production environments of the GCP. The technology environment specifications are as follows:

1. The GCP shall be hosted on Government Cloud (GovCloud) virtual servers.

2. The GCP shall be structured into three managed domains:
   2.1. Collaborative Group and Government Shared Services Domain
   2.2. Contextual Registry Domain
   2.3. Inter-governmental Data Warehouse Domain

3. The GCP architecture shall be service oriented and shall be tiered into the following *de-coupled* environments:
   3.1. Orchestration Environment
   3.2. Enterprise Service Bus/Middleware Environment
   3.3. Data Management Environment

4. The GCP environment shall be capable of supporting a minimum of 50,000 concurrent transactions per minute.

5. The GCP shall maintain a maximum latency of *1.5 seconds* for *search*; maintain a maximum latency of *3.0 seconds* for *transactions*; and, shall maintain a base *service uptime* of not less than 95.9999% SLA per year.
6. The GCP Orchestration Environment shall consist of:
   6.1. Enterprise Portal System
   6.2. Enterprise Web Server
   6.3. Identity Management System
   6.4. Enterprise Application Server
   6.5. Enterprise Business Intelligence and Analytics System

7. The GCP enterprise service bus environment shall consist of:
   7.1. Enterprise Middleware System
   7.2. Business Rules Management
   7.3. Automated Policy and Workflow Management
   7.4. API Management System (legacy and WSDL)
   7.5. Parsing and Concurrent Processing System
   7.6. Proxy and Routing Services

8. The GCP data management environment shall consist of:
   8.1. Enterprise Data Management
   8.2. Big Data Management System
   8.3. Enterprise Master Data Management Server
   8.4. Extract-Transform-Load (ETL) System
   8.5. Extensible Style sheet Language Template (XSLT) System
   8.6. Enterprise No-SQL Database Management System
   8.7. Enterprise Relational Database Management System
   8.8. Enterprise Data Warehousing / Data Mart System

9. The GCP application development environment shall consist of:
   9.1. Capability to support runtime applications in the following development environments: PHP, Java, and .NET.
   9.6. Standard integrated environment widgets to best-of-breed Software Planning tools such as Scrum and Open Unified Process, and must support agile or tradition software development lifecycle management processes.

GCP Core Application Environment (Orchestration Tier) Specifications
The GCP core application environment (orchestration tier) is a complete and base-configured GovCloud-resident platform of integrated standard applications where all next generation applications that serve the whole of government will be deployed, consisting of
an **Enterprise Portal**, an **Enterprise Web Server**, an **Identity Management System**, an **Enterprise Application Server**, and an **Enterprise Business Intelligence and Analytics System**.

**Enterprise Portal System**
The enterprise portal system will serve as the *standard entry point* into the GCP application environment through the use of *portlets* for administration functions such as application management, database management, identity and security permissions management, and virtual machine instance management, and transactional functions such as those involving the use of *government shared applications*.\(^{13}\) The enterprise portal system will provide a foundation for homogeneity in user experience.

The base specifications of the enterprise portal system are as follows:

- **Security Services**
  Must support single sign-on and standard security certification (X.509, SSL, OCSP/CRL, and PKCS12) protocols.

- **Standards Compliance**
  Must be JSR 168/286, WSRP 1.0/2.0 compliant

- **Integrated Systems Management**
  Must support integration services to the GCP application environment, business rules, events, data, and government shared applications.

- **Portal Management**
  Must provide UI-based integrated functionality to control all portal components, user transactions, provide access to log files, user permissions, and so forth.

- **Portlets**
  Must provide integrated environment to develop, configure, integrate, and deploy personalized end-user OLTP and OLAP applications. Portlets, at the minimum, must be able to efficiently render user interfaces developed using standard and semantic web specifications (inclusive of geospatial rendering standards). They must also be WSRP 1.0/2.0 compliant.

- **Policy Management**
  Must be able to govern SOA interactions through security and operational policy management and enforcement.


\(^{13}\) Refer to *Shared Applications, Page 32.*
Must support configurable mechanism to apply or remove a policy from a service.

Must support custom policy.

- **Integration Services**
  Must provide integrated UI-based management environment to manage integration to and from the ESB.

- **Reporting**
  Must provide UI-based functionality for users to perform user-defined and standard data extracts for both standard and ad hoc reports.

- **Collaboration Services**
  Must provide UI-based functionality for users to define, design, manage, route, and track workflows.

- **Unified Communication**
  Must provide UI-based functionality for secured online and GSM-based messaging, electronic mail, IP-based video conferencing, calendar and scheduling, task management, and workflow management.

  Must also provide social networking functionality.

- **Content Management**
  Must provide UI-based functionality for users to perform content authoring, collaborative review, content syndication, store, index, retrieve, organize and classify, and manipulate multimedia objects in both structured and non-structured formats.

- **Basic and Advanced Search**
  Must provide UI-based functionality for users to perform low latency basic search and parameter-based searches against structured and non-structured data repositories.

- **Uninterrupted Runtime Deployment of Application Customizations and Modifications**
  Must provide UI-based functionality for users to customize and deploy modifications to user interfaces, navigation flows, and content at runtime without the need to impose a mandatory server stop-start to restart the environment.

---

14 Refer to Page 53. "The GCP shall maintain a maximum latency of 1.5 seconds for search; maintain a maximum latency of 3.0 seconds for transactions; and, shall maintain a base service uptime of not less than 95.9999% SLA per year."
Enterprise Application Server Base Specifications

The main service function of the enterprise application server is to provide the essential abstraction to de-couple the presentation (user interface) and data tiers from the application tier regardless of the type or nature of an application. Given the scope of the GCP, it will need to maintain a heterogeneous environment capable of servicing and supporting standard Java, PHP, .NET and other platform independent environments inclusive of Open Source systems.

By design, the GCP will maintain Virtual Machine (VM) instances of base-configured enterprise application servers with integration adapters to:

1. GCP enterprise service bus.
2. Enterprise database repositories.
3. Standard connectors to the Java, PHP, or Microsoft .NET platforms and enterprise services.

The base specifications for the GCP Enterprise Application Server are as follows:

Features and Core Services

- Virtualized Environment Optimization.
- Must have high-availability clustering functions.
- Integrated Web Server services.
- Microservices support.
- Application Logic and Intelligent Routing.
- Garbage Collection.
- Comprehensive Technology Foundation Library.
- XML-based Application Configuration File Management.
- Must support the following open standards and specifications: JSP 2.1, JSF 1.2, Servlet 2.5, EJB 3.0, JAX-WS 2.0, JMS 1.1, JNDI 1.2, JCA 1.5, JTA 1.1, JACC and JAAS 1.0, JMX 1.2, J2EE Application Deployment 1.2, J2EE Management 1.1, JDBC 3.0, JAX-RPC, JAX-WS, Enterprise-class JMS, JPA, POJOs.
- Must have native support for REST, SOAP, UDDI, WSDL, WSRP, WS-Security.
- Must have Transaction Logging (TCP/UDP).
- Dynamic Clustering and High-Availability.
- Dynamic Fail-over Support.
- Dynamic Load Balancing Support.
- Standard Library of Database Connections (RDBMS, NoSQL) APIs.
- Managed Application Deployment and Migration Environment.
- Web Services Configuration and Deployment.
- OLTP Batch Processing Configuration and Management.
- Web 2.0 and Modular Application Development Support.
- Out-of-the-box support for Java EE, Microsoft .NET, and PHP applications.
- Automatic Resource Management.
- Cross Component Tracing.
- Integrated Development Tooling Support.
- Centralized Administration.
- Dynamic Memory Allocation (JIT-usage) and Termination.
- Dynamic Application State Roll-back Capabilities.

**GCP Enterprise Middleware (Service Bus) Environment Specifications**

The base specifications of the GCP Enterprise Middleware (enterprise service bus) Server are as follows:

**Basic Functionality**
- Distributed application management.
- Multi-OS support.
- Supports automatic workload balancing.
- Ability to support a wide range of protocols (namely HTTP, JMS, FTP, REST, File, WS-RM, MQ, SMTP, EJB, JCA, etc.) to provide a range of capabilities for newly developed business needs and to support integration with a wide range of third-party and legacy systems and services.
- Ability to accept a request in one protocol and forward it as a request using a different protocol.
- Ability to translate data from one format to another, possibly using that data to enrich data streams and make routing decisions along the way.
- Ability to connect multiple services together into a larger composite service, and manage the flow of control and information among the component services.
- Provide easy to use graphical editors for ESB flows using both standalone IDE and web-browser.
- Support file formats like XML, non-XML and binary.
- Provide uniform mechanisms for identifying, managing, and monitoring both technical and business errors, with the ability to customize specific error behavior as needed.

**Data Middleware**
- Support for Remote File Systems
- Support for Network File Systems
- Support for ODBC
- Support for JDBC
- Support for XDBC

**System Programming Interfaces**
- Support for Message Oriented Middleware
- Support for Java Message Service
- Support for Web Services Simple Object Access Protocol
- Support for Distributed Computing Environment
- Support for FTP, HTTP, S-HTTP, IP, SMTP, TCP
- Support for ebXML messaging, WSDL, UDDI
- Support for Service Oriented Architecture (SOA) and event-driven architecture
(EDA)

**Platform Middleware**
- Support for fourth-generation languages (4GL) and programmable Web Servers and Microservices Web Servers.
- Support for personalization, multi-channel access.
- Support for content management.

**Integration Middleware**
- Support for thick encapsulation Adapters.
- Support for thin encapsulation Adapters.
- Support for proprietary and open standard technical adapters and application adapters.
- Support for device and end-point physical devices.
- Able to control throttling and load balancing to meet SLAs on a per-endpoint basis.
- Ability to cache the static data to improve performance by configuration only.
- Ability to support multiple communications paradigms such as Request/response, Synchronous and asynchronous, One-to-many, many-to-one, Publish-Subscribe, Mix-and-match (e.g. sync-to-async), and split-joins.
- Ability to support Advanced Service Pooling such as Routing to active endpoints and service load balancing.
- Ability to support entire Service Lifecycle Management and Governance involving Metadata Repository & Service Registry.

**Data Navigation**
- Native support for SQL and XQuery

**Business Process Management**
- Integrated graphical process design tool.
- Native runtime execution engine.
- Transaction routing, monitoring and logging.
- Post-completion analysis capabilities.
- The proposed solution must be able to handle the various flavors of the real world business processes within the same unified BPM engine, i.e., system-centric, human-centric, document centric, decision centric, social centric and analytics centric processes.
- The proposed product must be based on open standards and not using proprietary languages or scripting to develop or deploy processes.
- Ability to support advanced routing logic within work processes, including routing based on business rules, routing based on LDAP.
- Hierarchy (e.g., routing to a person and three levels up to his managers), routing based on Voting Outcome percentage. This must be achieved through the software’s configuration dialog, not through custom coding.
- Provide a visual representation for viewing, creating, and editing processes via both IDE and web-based modeling tool. The models generated should be “what you model is what you execute (WYMIWYE).”
- Provide native support to execute BPMN 2.0, BPEL 1.1 and BPEL 2.0 processes within the same unified engine.
- Ability to allow web-based modeling, service configuration, deployment and testing using web-based console.
- Easy-to-use front-end and integration with portal to provide unified user experience and role-based UI.
- Should support collaboration capability with the enterprise portal.
- Ability to easily create new process flows or modify existing flows as business needs dictate.
- Provide packaged "templates" of common workflow processes that can be used as a starting point.
- Ability to support repeatable process.
- Ability to support sub-process.
- Ability to integrate with the document repository for online document access.
- Ability to serve as basis for fully automated processing (i.e. with no human participation).
- The proposed product should provide an OOTB work list portal for process and workforce management.
- Ability to design serial, parallel, and complex processes.
- Version control on flow definitions.
- Ability to escalate work if not addressed within specific timeframes.
- Ability to generate notifications (such as email, SMS, voice, IM) for high priority, escalations, pending and overdue work items.
- The proposed product should provide API / web service that allows other applications to access work list.
- Ability to queue and reroute work based on resource availability. Round-robin assignment for a group of users should be provided OOTB.
- Ability to set reminders, deadlines and delegation.
- Built-in advanced human patterns such as escalation, re-assignment, withdraw, suspend, claim and resume.
- OOTB ability for users to specify their Business calendars which allows expiration and escalation times specified on activities to be measured in “business hours” rather than arbitrary ‘wall clock’ time which may produce incorrect results around holidays and weekends.
- Ability for users to specify delegates to complete their work tasks when they are unavailable.
- Ability to share the comments and attachments with users participated in the same work process instance.
- Ability to allow users to view the history of the process instance that he / she is working on.
- Ability to allow users to view audit trail of the process instance that he / she is working on.
- Ability to perform simulation in desktop application and web-based console.
- Ability to do documentation of processes / activity and generate as HTML / XML.
- Ability to integrate with other systems to access work tasks (e.g. email inbox, line-of-business, applications, etc.).
- Ability to allow process owner / administrator to alter the flow of running process instances;
- Provides a visual guide on the outstanding tasks to complete in order to accomplish the work. Milestones can be defined and setup along the process. This feature is commonly known as “Activity Guide.”
- Provide “Player” feature in web-based console, which allows user to run and step through the business process in order validate the business flow, the business rules, and the associated user interfaces. This feature must provide a visual audit of the process flow during the testing.
- Ability to allow business users to easily create web form (rich, dynamic, user interfaces) for their business processes by dragging and dropping controls from the UI palette in web-based console. The fields in the web form will then be auto-generated into business objects for workflow execution.
- Provide “Adaptive Case Management” feature where enable organization to handle unstructured, ad-hoc processes and their contents and information.
- Support for importing from Visio and XPDL that is a built-in feature of the software, and fully supported by the software annual maintenance.
- The business process must be able to generate a Web service interface using in-built configuration dialog to be invoked by external applications.
- The business process must be able to generate a message interface (JMS) using in-built configuration dialog to be invoked by external applications sending a JMS message.
- The business process must be able to be configured using in-built configuration dialog to be started by timer schedule including: specific time of the day (e.g., 8 AM), specific days in the week (e.g. Every Monday), and specific days in the month.
- The platform must be scalable and provide high availability and performance.
- The platform should be easily able to easily scale appliances such as engineered systems and derive the out-of-the-box performance benefits.
- The proposed solution must include a data management system for application objects that are shared across multiple servers, require low response time, very high throughput, predictable scalability, continuous availability and information reliability.
- The proposed solution must include easy to configure HTTP session management module dedicated to managing session state in the clustered environments.
- The proposed software must have public website with samples, tutorials provided by the product team and member of the public.

**Business Rules Engine**
- Native UI-based Business Rules Management.
- Logic Complexity Management.
- Provide OOTB dashboards and custom dashboards that can be created by business users without IT intervention.
- Should have built-in adapter to propagate the runtime business KPI from BPM
engine to the real-time Dashboards.

- Provide easy to use web based editor for creating and editing rules. These tools must be part of the unified design-time environment.
- Ability to allow business users to change the business rules. The changes should be able to take effect immediately.

**Business Activity Monitoring**

- OOTB support real-time, broad and deep, multi-source and multi-channel event monitoring.
- OOTB support multi-source and multi-channel event analytics.

**Data Management Environment (Big Data and Data Warehousing) Specifications**

**Master Data Management System Features and Core Services**

- Native integrated graphical development toolset.
- Native tool-based multi-source identification and connection.
- Supports rules-based administration.
- Supports error detection and correction.
- Provides tools-based master data design functions for data quality management, classification, taxonomy design, item master creation, schema mapping, product codification, data enrichment and governance.
Supports automated and rules-driven extraction, transformation, and loading (ETL) processes of transactional and big data elements to the inter-government enterprise data warehouse.\textsuperscript{15}
- Supports automated and rules-based XSLT transformation.
- Supports Big Data processing and transformation functions.

**Data Warehousing System Features and Core Services**
- Provides native support for universal access
- Provides native metadata management functions
- Provides native data structure optimization functions
- Provides native real-time integration functions for on-premise or cloud based data objects
- Provides native integrated data quality management functions;

**GCP Virtual Machine Container Specifications**

*Table 6 - GCP VMC Compute Environment Specifications*

<table>
<thead>
<tr>
<th>VIRTUAL MACHINE CONTAINERS</th>
<th>ID</th>
<th>CORES</th>
<th>RAM (GB)</th>
<th>HDD (TB)</th>
<th>NAS (TB)</th>
<th>VM OS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCP Extra Small</td>
<td>GCPXSM</td>
<td>4</td>
<td>16</td>
<td>1</td>
<td>1.5</td>
<td>Linux, Win</td>
</tr>
<tr>
<td>GCP Small</td>
<td>GCPSMSM</td>
<td>8</td>
<td>32</td>
<td>4</td>
<td>6</td>
<td>Linux, Win</td>
</tr>
<tr>
<td>GCP Large</td>
<td>GCPPLG</td>
<td>16</td>
<td>64</td>
<td>16</td>
<td>24</td>
<td>Linux, Win</td>
</tr>
<tr>
<td>GCP Extra Large</td>
<td>GCPXLG</td>
<td>32</td>
<td>128</td>
<td>64</td>
<td>96</td>
<td>Linux, Win</td>
</tr>
<tr>
<td>GCP Double Extra Large</td>
<td>GCPXXL</td>
<td>64</td>
<td>256</td>
<td>128</td>
<td>192</td>
<td>Linux, Win</td>
</tr>
<tr>
<td>GCP Enterprise Basic</td>
<td>GCPENB</td>
<td>128</td>
<td>512</td>
<td>256</td>
<td>384</td>
<td>Linux, Win</td>
</tr>
<tr>
<td>GCP Enterprise Large</td>
<td>GCPENL</td>
<td>256</td>
<td>1024</td>
<td>512</td>
<td>768</td>
<td>Linux, Win</td>
</tr>
</tbody>
</table>

*Table 7 - GCP VMC Application and Integration Services Specifications*

<table>
<thead>
<tr>
<th>VIRTUAL MACHINE CONTAINERS</th>
<th>ID</th>
<th>PORTAL</th>
<th>WEB/APP</th>
<th>MIDDLEWARE</th>
<th>ANALYTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCP Extra Small</td>
<td>GCPXSM</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GCP Small</td>
<td>GCPSMSM</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GCP Large</td>
<td>GCPPLG</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>GCP Extra Large</td>
<td>GCPXLG</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>GCP Double Extra Large</td>
<td>GCPXXL</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>GCP Enterprise Basic</td>
<td>GCPENB</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>GCP Enterprise Large</td>
<td>GCPENL</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

\textsuperscript{15} Must be backward or legacy system compatible to support data extraction from 16-bit and 32-bit environments.
### Table 8 - GCP VMC Data Management Services Specifications

<table>
<thead>
<tr>
<th>VIRTUAL MACHINE CONTAINERS</th>
<th>ID</th>
<th>SQL DB</th>
<th>NO SQL DB</th>
<th>MDM</th>
<th>BPM</th>
<th>BIG DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>GCP Extra Small</td>
<td>GCPXSM</td>
<td>✗</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✗</td>
</tr>
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### Table 9 - GCP VMC API Library Services Specifications

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### Table 10 - GCP VMC Management Tools and Services Specifications

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### Table 11 - GCP VMC Potential Usage

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<th>CORPORATE INTRANET</th>
<th>E-COMMERCE WEBSITE</th>
<th>UNIFIED COMMUNICATION</th>
<th>APPLICATION SERVER</th>
<th>ENTERPRISE MIDDLEWARE</th>
<th>DEVELOPMENT &amp; TESTING SERVER</th>
<th>STAGING &amp; DATABASE</th>
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