Cost of Identification Systems

Model Guidance Note: Assumptions and Methodology

WORLD BANK GROUP

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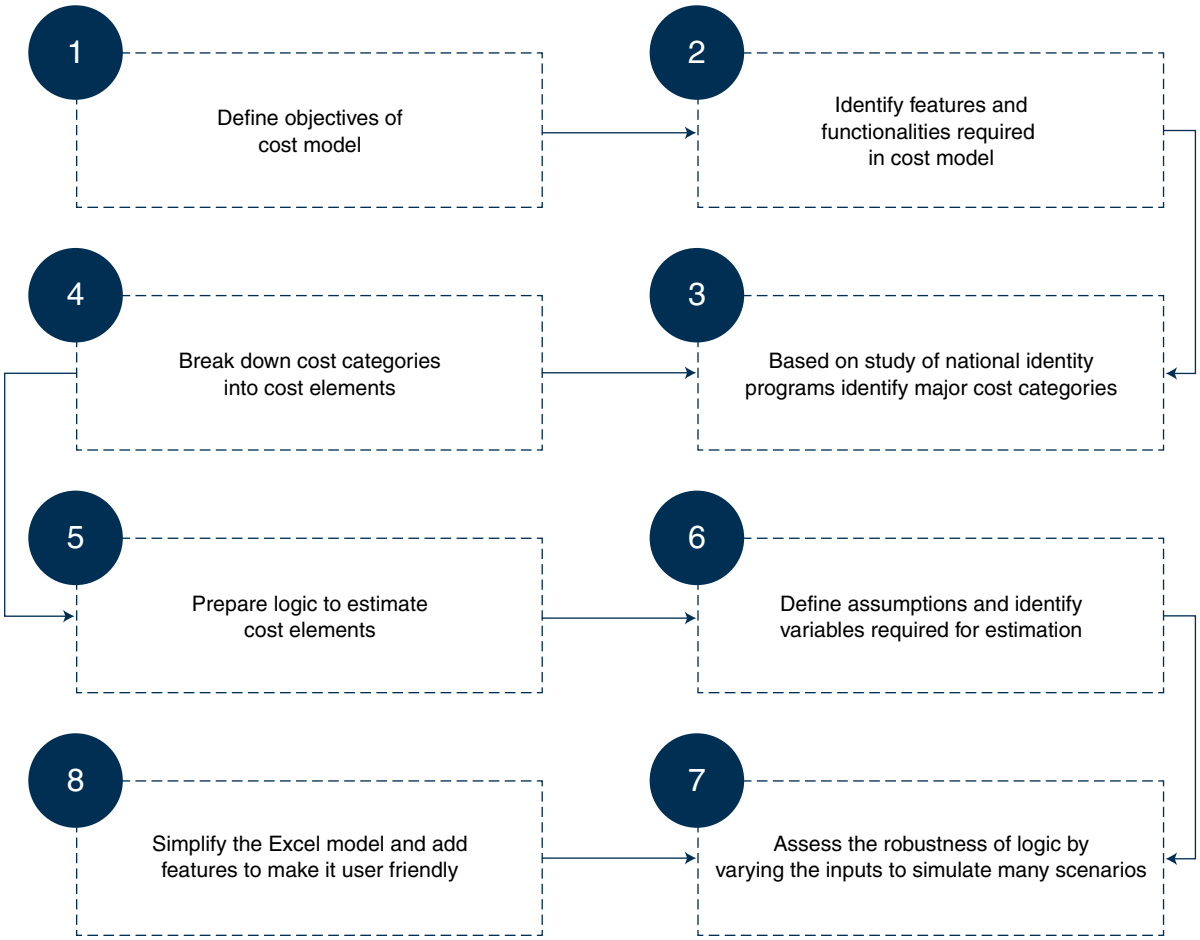
1. Cost Model

The learnings from the cross-country study have been used to develop a reference cost model that incorporates the global best practices for procurement, implementation, and sustainability of digital ID systems adopted by different countries. **This reference model is designed to assist in economic** evaluation of costs associated with **the different ID system design choices** (e.g., issuing a chip-based ID card vs. a paper-based ID, short enrolment period vs. a long enrolment period, fingerprint biometric technology vs. multi-modal biometric technology, and so on).

1.1 Overview

The reference cost model estimates the expected cost of developing and sustaining a national ID system in a number of different scenarios. Figure 1 summarizes the high-level approach adopted to prepare the model.

Figure 1. Methodology for Cost Model



1.1.1 Objectives

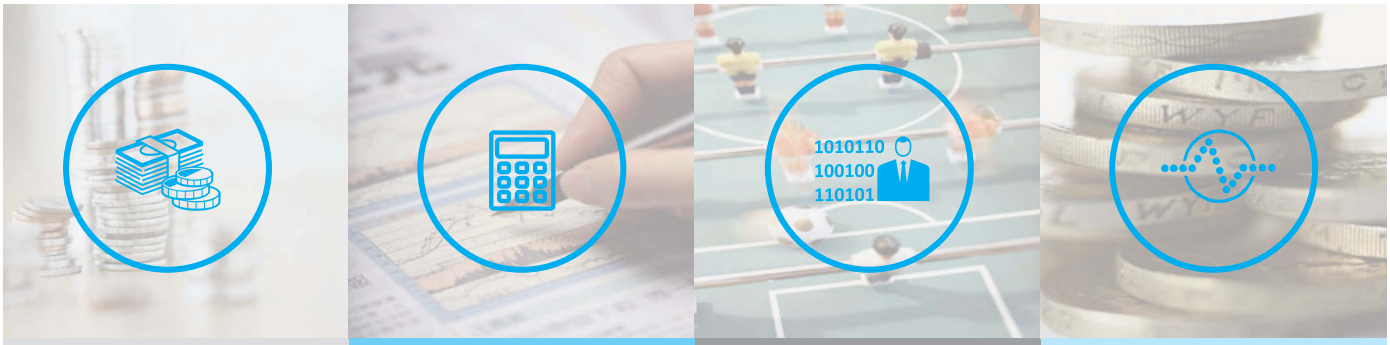
The reference cost model seeks to estimate cost ranges for a national ID system in different scenarios, which countries could use to evaluate the expected cost of developing such ID systems.

1.1.2 Key features

The features of the reference cost model are shown in Figure 2.

1.1.3 Limitations of the reference cost model

Figure 2. Features of Cost Model



Feature 1	Feature 2	Feature 3	Feature 4
Estimates cost associated with developing and sustaining a national identity system under different design choices.	A simple user input-driven model (Excel-based), where the user can select from different options for a number of design choices and generate corresponding estimates.	Supports side-by-side comparison of cost estimates generated from multiple scenarios, thereby allowing the user a clear view of the impact of different design choices on the overall cost of the program.	Allows user to manually adjust variables to refine the model to incorporate country-specific variations to increase the accuracy of estimation.

- The cost estimation for implementation of the national ID system with a particular set of design choices are indicative only, and may be influenced by certain parameters that are not included in the cost estimation due to inability to assess the impact of such variables accurately.
- The cost estimation is for a green field implementation and does not include the cost of technical and physical infrastructure that may already be available with the ID agency.
- Cost of raising capital is not included in the cost estimation. This may increase the cost of the program.
- The model does not optimize the resource allocation most effectively. In reality, human resources and physical and technical infrastructure can be further optimized to reduce the program cost.
- All the estimations are done in U.S. dollars (USD), and countries should use appropriate projection of exchange rates to estimate costs in local currency units.
- Total cost of the program may significantly change with the procurement strategy adopted. A country with limited technical expertise may procure more services from large systems integration/ managed service provider (SI/MSP), which may result in an increase in the total project cost. Apart from available expertise in the form of human resources, risks associated with the country (political/ financial), the bidding process (open/close), and tax laws affect overall estimation of program costs.

As most of these situations cannot be parameterized for each country, the model will not be able to account for impact in overall cost due to such variations. Hence, it has been assumed that the country under consideration will have a competitive bidding procedure that will help market forces strongly influence price discovery with payment terms that could mitigate political and financial risk and avoid padding of costs by SI. Taxes are not included in the cost estimation and should be added separately as per country-specific tax laws.

1.2 Methodology

A detailed cost estimation methodology for each of the above categories and how it can be used to adequately project costs for a 'green field' ID system based on prevailing country characteristics and design choices selected by a government is elaborated in the Reference Cost Model tool (this can be accessed by contacting the World Bank ID4D Group). The section below briefly outlines the capabilities and design features of the cost model:

1.2.1 User inputs for the cost model

The cost model has three primary data input categories:

- Key design choices
- Country characteristics
- Predefined variables

1.2.1.1 Key design choices

From the evidence gathered through the cross-country study, there are **five** specific design choices that demonstrated the greatest impact on the overall program cost. In broad terms, the impact was visible across both the start-up phase and steady state of their ID systems, to varying degrees across countries. These design choices are mandatory variables for the model. The five design choices are as follows:

- Choice of biometrics
- Choice of credentials
- Enrolment timelines
- Number of biographic fields
- Linkage with civil registration

1.2.1.2 Country characteristics

Defining the individual country characteristics is critical for the reference cost model to provide reasonable cost estimations. The country characteristics that have a high impact in costs are included as **mandatory** parameters in the cost model. They include:

- Population
- Average population growth rate
- Average birth rate
- Percentage of rural population
- GNI per capita USD PPP, 2016
- Number of regions/provinces
- Number of districts/municipalities

1.2.1.3 Predefined variables

To keep the cost estimation customizable as per different country scenarios and amendable to future modification, a number of parameters/coefficients are defined and listed separately. These values were predefined on the basis of industry experience, interaction with experts, and learnings from various global study reports. Though these inputs are not essential to be modified in the cost model, it is recommended that a user refine these values in order to get more accurate estimations for the country.

These predefined variables are further divided into three categories:

- **Unit cost variables:** This outlines all the assumed unit costs of various elements required for estimating capital and recurring costs—e.g., the cost of software systems and enrolment kit components, expenses related to office facilities, and so on. The unit cost of these components varies from country to country because of many factors, such as location of manufacturer and buyer, key SLAs, functional and technical requirements, procurement strategy, local country taxes, etc. Hence, these values may be refined by the user to represent actual costs in the country under consideration.
- The detailed unit cost assumptions used in the cost model are mentioned in Annex B.
- **Human resource costs:** This outlines wage levels on the basis of a three-tier organizational structure (popularly observed across countries). As discussed in earlier sections of this report, the human resource cost is a significant component in the ID system. Hence, it becomes essential that the organization structure in the model depicts a realistic scenario for estimating human resource requirements and wages.
- **Default parameters:** This outlines a number of standard parameters used in formulae for estimating costs across categories. This provides flexibility to the user to customize formulae as per country characteristics, for instance, the percentage of people using call center facilities to register grievances, the percentage of the population to be enrolled by employing mobile enrolment stations, etc.

The default parameters for the cost model for each cost category are mentioned in Annex B.

It must be noted that cost estimations provided by the model are indicative and merely a reference guideline for governments planning a national ID system. Actual implementation costing with a similar set of design choices may result in variation from the model output cost due to different on-ground realities and country characteristics.

1.2.2 Cost categories

For the purpose of cost estimations across key program components, the ID life cycle is divided into seven core categories. Cumulatively, these address most of a national ID system's implementation cost. The seven categories are as follows:

- Enrolment
- Human resource
- Software development
- IEC, helpdesk, training, and capacity building
- Administration facilities
- Identity credentials
- Central IT infrastructure: data center and disaster recovery

As discussed in earlier sections, the implementation of a foundational national ID system can be divided into two phases:

- The start-up phase, which includes activities such as planning and designing the national ID program, developing the ID system, nationwide roll-out of the program and enrolment of 90 percent of the eligible population.
- The steady state phase, which includes activities such as enrolment of new population into the system to increase or maintain ID coverage, maintenance of the ID database, resolution of citizen grievances (replacing old credential, renewing data fields, etc.) and authentication of individual identity.

The subsequent sections elaborate the cost estimation methodology for each of these cost categories. The methodology is divided into the following headers:

- Category description—this is a summarized description of the cost category
- Cost items included—this outlines the descriptions of various cost components that are included in the estimation of capital and operational costs
- Key inputs required—this outlines the descriptions of category-wise inputs necessary to perform cost calculations
- High level methodology—this outlines the description of major steps involved in cost estimations
- Key assumptions—this outlines the description of key assumptions made to estimate costs
- Detailed methodology diagram—this contains the detailed methodology flow chart

1.2.3 Detailed methodology

Table 1 through Table 7 show each cost category with detailed methodology. The figures for major steps followed can be found in Annex A.

Table 1. Detailed Methodology for Enrolment

Cost Category: Enrolment		
Category Description	**Estimation of Expenditure for Enrolment of Residents/Citizens in National ID Program**	
Cost Items Included	Capital Expenditure	■ Enrolment kits ■ Replacement of enrolment kit due to technology refresh cycle ■ Enrolment station setup cost ■ Vehicle for mobile enrolment stations
	Operating Expenditure	■ Maintenance of enrolment kit ■ Maintenance of enrolment stations ■ Facility and utility expenditure ■ Maintenance and operating expenditure for mobile enrolment vehicles
Key Inputs Required	Key Design Choices	■ Enrolment timeline ■ Choice of biometrics ■ Number of biographic fields ■ Linkage with civil registration department ■ Eligible population for enrolment

(continued)

Table 1. Continued

Cost Category: Enrolment		
Category Description	**Estimation of Expenditure for Enrolment of Residents/Citizens in National ID Program**	
Key Inputs Required	Country Characteristics	■ Population ■ Population growth rate ■ Birth rate ■ Rural population
	Other variables	■ Working hours per year ■ Efficiency of enrolment stations (mobile and fixed)
High-Level Methodology	■ Estimation of per person enrolment time ■ Estimation of enrolment stations required for only new enrolments ■ Estimation of additional enrolment stations required for helpdesk queries ■ Estimation of additional enrolment stations required for mandatory biometric data update requests	
Key Assumptions	■ Population estimation: Population growth rate is projected for upcoming years using the average population growth rate (input). Similarly, number of births each year is estimated using the average birth rate (input). ■ To estimate the year-on-year volume of enrolments, normal distribution curve is followed during enrolment phase and birth rate is considered during steady state. ■ Efficiency of mobile enrolment station is considered lower then fixed enrolment station. Mobile enrolment stations will be required to enrol population residing in remote areas or disabled people. ■ Tech refresh of enrolment kits is kept as 4 years. Although it can be changed in input assumptions. ■ To estimate the volume of mandatory biometric update requests, birth rate is considered. ■ During start-up phase as well as steady state phase each district will have minimum one active enrolment station. ■ Mobile enrolment stations will use a vehicle to conduct enrolments; per two enrolment stations one vehicle will be procured to facilitate the same.	
Detailed Methodology Flow Chart	See Annex, page 18.	

Table 2. Detailed Methodology for IEC, Helpdesk, and Training

Cost Category: IEC, Helpdesk, Training, and Capacity Building		
Category Description	**Estimation of Expenditure on IEC, Helpdesk, Training, and Capacity Building Exercise**	
Cost Items Included	Capital Expenditure	■ Training material development costs, such as training modules, video lecture, pamphlets, information booklets, tutor's notes, assessment modules
	Operating Expenditure	■ Facility cost for training ■ Tutor cost ■ Trainee allowances and certification cost ■ Outsourcing cost of call center and online complaint portal ■ IEC cost
Key Inputs Required	Key Design Choices	
	Country Characteristics	■ Per person IEC cost
	Other Variables	■ No. of service providers ■ Percentage of people require helpdesk
High-Level Methodology	1. Helpdesk cost ■ Estimation of total helpdesk request volume at enrolment stations, call center, and online portal ■ Estimation of efforts required to resolve the request at enrolment station ■ Estimation of time required to resolve the request through call center and online portal 2. Training and capacity building cost ■ Estimation of annual trainees for training and capacity building exercise (trainees will be operators, service provider agencies employees, and ID agency employees) ■ Estimation of total batches required for training ■ Estimation of per batch training cost 3. IEC cost ■ Estimation of IEC cost using per person IEC cost	
Key Assumptions	■ Time taken per query/grievance resolution is equal to enrolment time. ■ Residents have three options (online portal, call center, and enrolment station) to register their query/complaints. Number of enrolment stations are increased to accommodate these requests and the cost for same is estimated in enrolment category. ■ Call center and online portal will be outsourced to third party. Payment will be made on the basis of number of agent hours required. Apart from this variable cost, annual fixed cost for toll free no. and associated services will be charged. ■ Initially enrolment operator, ID agency employee, and service provider agency will be given a 2-day training in batch of 15 people. Post that, each year 25% of the employees will participate in refresher trainings annually. ■ IEC (citizen engagement) activities will be conducted by third party on the outcome base model (per enrolled person cost). ■ IEC cost per person during steady state will reduce to 25% as compared to enrolment phase cost.	
Detailed Methodology Flow Chart	See Annex, page 19.	

Table 3. Detailed Methodology for Human Resource

Cost Category: Human Resource		
Category Description	**Estimation of Expenditure on Human Resource (Salary and Allowances) Required to Implement ID Program**	
Cost Items Included	Capital Expenditure	
	Operating Expenditure	■ Salary ■ Allowance ■ One time hiring cost
Key Inputs Required	Key Design Choices	■ Linkage with civil registration department ■ Requirement of regional and district level offices
	Country Characteristics	■ GNI per capita
	Other Variables	■ Number of operators required at one enrolment station ■ Organization structure—level wise resources ■ Hiring cost as percent of human resource cost
High-Level Methodology	■ Estimation of human resource requirement at headquarters ■ Estimation of human resource requirement at regional and district level ■ Estimation of salary and allowance	
Key Assumptions	■ A three-tier organization structure is considered—headquarters, regional/province offices, and district offices. Enrolment operators are considered as part of district level office. Type of offices and number of offices required are user inputs. ■ As benchmark salary, wage estimates of Bureau of Labor statistics (USA) is considered; this value is then multiplied with ratio of per capita income for selected country and USA to estimate the wage levels for selected country. Additional allowances have also been included in the salary as per resource experience and skill set.	
Detailed Methodology Flow Chart	See Annex, page 20.	

Table 4. Detailed Methodology for Central IT Infrastructure

Cost Category: Central IT		
Category Description	**Estimation of Expenditure on Data Center and Disaster Recovery Site**	
Cost Items Included	Capital Expenditure	■ Setup cost ■ Hardware cost
	Operating Expenditure	■ Hardware maintenance cost ■ Facility maintenance cost
Key Inputs Required	Key Design Choices	■ Enrolment timeline ■ Number of biometric fields ■ Number of demographic fields
	Country Characteristics	
	Other Variables	■ Preferred biometric for authentication ■ Per agency per person per year authentication request ■ Capacity of servers
High-Level Methodology	■ Estimation of server requirements (web server, database server, and application server) ■ Estimation of data storage requirements	
Key Assumptions	■ Peak load factor is considered as double of average workload. ■ Storage disk utilization is considered as 50%. ■ Disaster recovery is same as data center capacity.	
Detailed Methodology Flow Chart	See Annex, page 21.	

Table 5. Detailed Methodology for Identity Credential

Cost Category: Identity Credential		
Category Description	**Estimation of Expenditure on Identity Credential**	
Cost Items Included	Capital Expenditure	
	Operating Expenditure	■ Cost of identity credential including delivery cost
Key Inputs Required	Key Design Choices	■ Type of identity credential
	Country Characteristics	■ Credential delivery cost
	Other Variables	
High-Level Methodology	■ Estimation of annual new identity credential requirement ■ Estimation of annual identity credential requirement due to lost or damage of old card ■ Estimation of per identity credential cost as per credential features	
Key Assumptions	■ Total cost of identity credential = cost of material + cost of associate technology (chip based, barcode, mag strip) + cost of printing + cost of security feature + cost of delivery	
Detailed Methodology Flow Chart	See Annex, page 22.	

Table 6. Detailed Methodology for Administration Facilities

Cost Category: Administration Facilities		
Category Description	**Estimation of Expenditure on Office Premises Used for Administration**	
Cost Items Included	Capital Expenditure	■ Office setup cost ■ Work station setup cost
	Operating Expenditure	■ Rent for office space ■ Office consumables and utilities costs ■ Office maintenance cost
Key Inputs Required	Key Design Choices	■ Linkage with CRVS
	Country Characteristics	■ Number of offices required
	Other Variables	■ Cost of setting up office ■ Cost of office maintenance and utilities
High-Level Methodology	■ Estimation of total office setup cost and workstation cost ■ Estimation of operating expenditure using per sq. ft. maintenance, repair, and utilities and cleaning cost	
Key Assumptions	■ Office at three levels are assumed (headquarters, province/regional level, and district level). ■ Office spaces are taken on annual lease.	
Detailed Methodology Flow Chart	See Annex, page 23.	

Table 7. Detailed Methodology for Software

Cost Category: Software		
Category Description	**Estimation of Expenditure on Software Development/Procurement and Maintenance**	
Cost Items Included	Capital Expenditure	■ Development/procurement of various software required for national ID implementation
	Operating Expenditure	■ Software AMC ■ Deduplication ■ Human resource cost for manual checking
Key Inputs Required	Key Design Choices	■ Choice of biometrics
	Country Characteristics	
	Other Variables	1. AMC cost as % of development cost 2. % of cases require manual checking 3. Per deduplication cost
High-Level Methodology	■ Identification of software required for national identity system implementation ■ Estimation of identified software cost ■ Estimation of human resource requirement for manual checking	
Key Assumptions	■ The system software as well as data center software have been included in this category. ■ Application software will be procured/developed from/by third party. ■ Deduplication will be done using third-party algorithms. The third-party ABIS provider will charge ID agency on per deduplication basis. ■ Deduplication will be done using composite biometrics, if more than one biometric is being captured. ■ By default AMC cost is taken as 25% of the software development cost.	
Detailed Methodology Flow Chart	See Annex, page 24.	

Default Parameters

Table 8 depicts the unit cost assumptions taken in the cost model. The cost of the item/service can be varied in the model in the Unit Cost Assumptions sheet.

2. Annexes

2.1 Annex A: Unit Cost Assumptions

Table 8. Unit Cost Assumptions

Name of the Item/Service	Description
Computer/Laptop	
Mobile/Tablet	
Camera/Webcam	
Multifunction Printer	
Power Backup	
Finger Print Scanner—One Finger	
Finger Print Scanner—Slab Scanner	Greenbit DactyScan84C
Iris Scanner—One	
Iris Scanner—Two	I Scan 2 from Cross Match
Signature Pad	
GPS Dongle	
Additional Screen	
Voice Recording Device	
Case for Kit	
Annual Operating Expenditure per Enrolment Station	Cost of utilities (electricity, water, Internet), rent for space, maintenance of devices and space, etc.
Enrolment Station Setup Cost	Setup cost includes cabling cost, electricity fitting cost, furniture cost, banner cost, first aid kit, etc.
Cost per Hour for Outsourcing Call Center	This includes cost of agent, call center management, and other call center related expenditures
Toll Free Number Annual Cost	Cost of acquiring and managing toll free number
Training Modules Cost	Training modules will be required for training and capacity building activities for ID agency staff. This cost includes cost of video modules, pamphlets, assessment modules, information booklets, teacher's notes, etc.
Per Batch Training Cost	Cost for training batch of 15 people. This includes cost of space, equipment, stationery, snacks, tutor fee, certification, and allowance to trainees.
Enrolment Client and Server	
Data Synchronization Software	

Name of the Item/Service	Description
Data Validation Tool	
CRM Tool	
Verification Client and Server	
Notification System	
Identity and Access Management System	
Portal	
Fraud Detection System	
Report System	
Cost per Deduplication (for first biometric)	
Add on Deduplication Cost for Additional Biometric	
Per Person Work Station Setup Cost	Cost of associated technical infrastructure, i.e., laptop, landline, stationery, etc.
Per sq. ft. Office Setup Cost	Cost of office setup
Per Person per Year Operating Expenditure	Stationery, snacks, etc.
Per sq. ft. Office Operating Expenditure	Cost of electricity, Internet, security, cleaning, admin., etc., per year
Office Rent per sq. ft.	
Cost of Identity Credential Components	
1D Barcode	
2D Barcode	
Contact Chip	Type of chip
Contactless Chip	Type of chip
Dual Interface Chip	Type of chip
Hybrid Chip	Type of chip
Mag Strip	
Paper	Type of credential material
PVC	Type of credential material
PC	Type of credential material
PET	Type of credential material
Teslin	Type of credential material
Composite (PC+PVC)	Type of credential material
Thermal Printing	
Printing on PVC and Equivalent	
Printing on PVC and Equivalent Smart Cards	
Level 1 (overt)	Security feature
Level 2 (covert)	Security feature

(continued)

Table 8. Continued

Name of the Item/Service	Description
Level 3 (forensic)	Security feature
Credential Delivery Cost	Cost of delivering credential to resident
Data Center Site Operating Cost	Security, space, site management, maintenance, WAN, etc.
Data Center Site Installation Cost	
Web Server Cost	Dell PowerEdge R730, 16 core, 2U
Application Server Cost	Dell PowerEdge R740, 16 core, 2U
Database Server Cost	Dell PowerEdge R940, 16 core, 3U
Disk Aarray	EMC VNX series, 10 TB
Load Balancer	Radware
Unified Threat Management	Fortigate
One Time Password Hardware	Gemalto
SAN Switch	Brocade 6520, 48 Port Fibre
Core Switch	NetApp FAS6200, 1.5 u
Tape Library	NetAPP
NAS	Tandberg
Middleware Software and Firewalls	E.g., JBOSS
Database Software	E.g., Postgresql
Biometric Verification Tool	Custom developed
Demographic Verification Tool	Custom developed
Caching Software	E.g., MemCache
Clustering Software	E.g., Apache Mesos
Replication Software	E.g., Postgresql, Storage volume replication
VM Software	E.g., VMWare
Vehicle for Mobile Enrolment	E.g., Jeep

2.2 Annex B: Default Parameters

Table 9. Default Parameters

Cost Category	Parameter	Description
Enrolment	Target coverage during enrolment phase	% eligible population
	Working hours per day	
	Working days per year	
	Fixed enrolment station working efficiency	
	Mobile enrolment station working efficiency	
	% of rural population require mobile enrolment station	The % of rural population which will require mobile enrolment stations. Kindly note that this is % of rural population, not entire population.
	Mandatory biometric update requirement	If upon turning to certain age, residents are required to update their biometric data then 1, else 0
Human Resources	No of employee at each station	Operator and verifier
	Hiring cost	% of total annual compensation
	Inflation	Average inflation for US$
	% of people require helpdesk	Out of total enrolled population these many people will require helpdesk for issue resolution each year
	Out of these people, % of people registering/ resolving complain through call centre	
	% of people registering/resolving complain through visit to enrolment station	Rest of the people will use online portal for issue resolution
	Number of operators that will be trained	Higher number of people will be trained for enrolment
	Total number of service provider agencies	Out of all the deduplication requests, these many requests will require manual checking
	Per agency number of operators who require training	
	Per person IEC expenditure during enrolment phase	Per person expenditure for IEC campaigns for whole enrolment period. During steady state this amount is reduced to 25%.
Software	Software AMC cost	As percentage of cost of software development
	Request require manual deduplication	Out of all the deduplication requests, these many requests will require manual checking
	Per manual deduplication time (in minutes)	
	Time taken per quality check	Minutes

(continued)

Table 9. Continued

Cost Category	Parameter	Description
Facility Cost	Headquarter space requirements	Sq. ft.
	Regional office space requirements	Sq. ft.
	District office space requirement	Sq. ft.
	ID to be issued	Due to lost or damage
Central IT	Per agency per person per year authentication requests	Used to estimate the authentication volume
	Preferred biometric for authentication	0 = no biometric authentication, 1 = fingerprints, 2 = iris, 3 = voice, 4 = face
	Preferred biometric for deduplication	1 = fingerprints, 2 = iris, 3 = voice, 4 = face
	Per person raw data size	In KB (including data update requests)
	Per person minutiae size	In KB
	Capacity of DR as compared to DC	
	Storage disk minimum size	In tb
	Number of core in webserver	
	Number of core in database server	
	Number of core in application server	
	Hardware AMC	As % of total cost of hardware
	Web server capacity (no. of request per second per core)	
	Application server capacity (number of requests per core per second)	1 request is equivalent to one fingerprint authentication request
	Data base server capacity (number of requests per core per second)	
	Fingerprint deduplication matches per core per second	For two finger biometric deduplication
	Iris deduplication matches per core per second	
	Face deduplication matches per core per second	
	Voice deduplication per core per second	
CRVS Linkages	Reduction in infrastructure cost due to shared infra	IF CRVS and ID agency are sharing infrastructure, then infrastructure will be reduced by this %
	Reduction in human resources cost due to shared human resource	IF CRVS and ID agency are sharing human resources then infrastructure will be reduced by this %

2.3 Annex C: Detailed Procedure

Figure 3. Flowchart for Enrolment

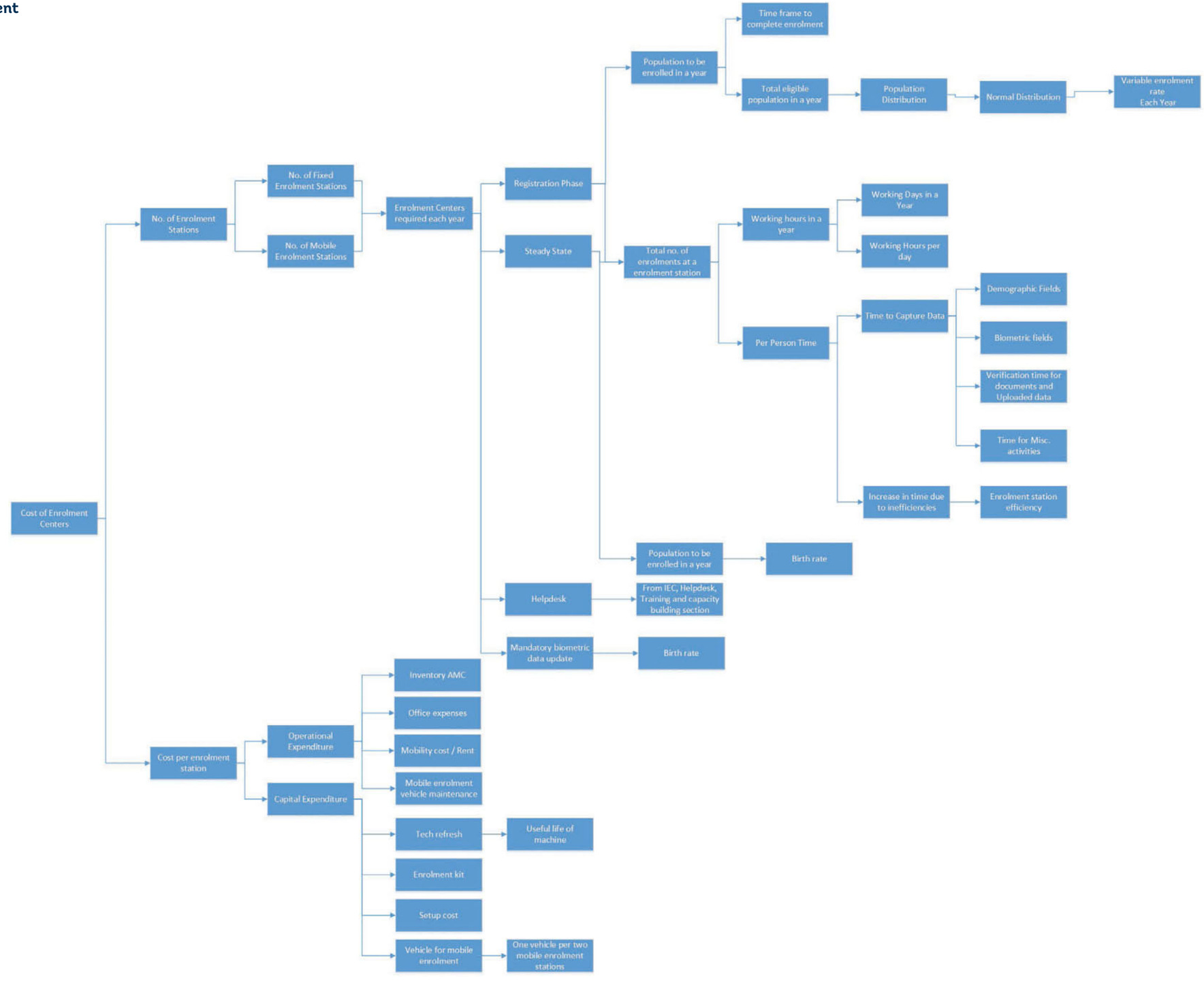


Figure 4. Flowchart for IEC, Helpdesk, and Training

Figure 5. Flowchart for Human Resource

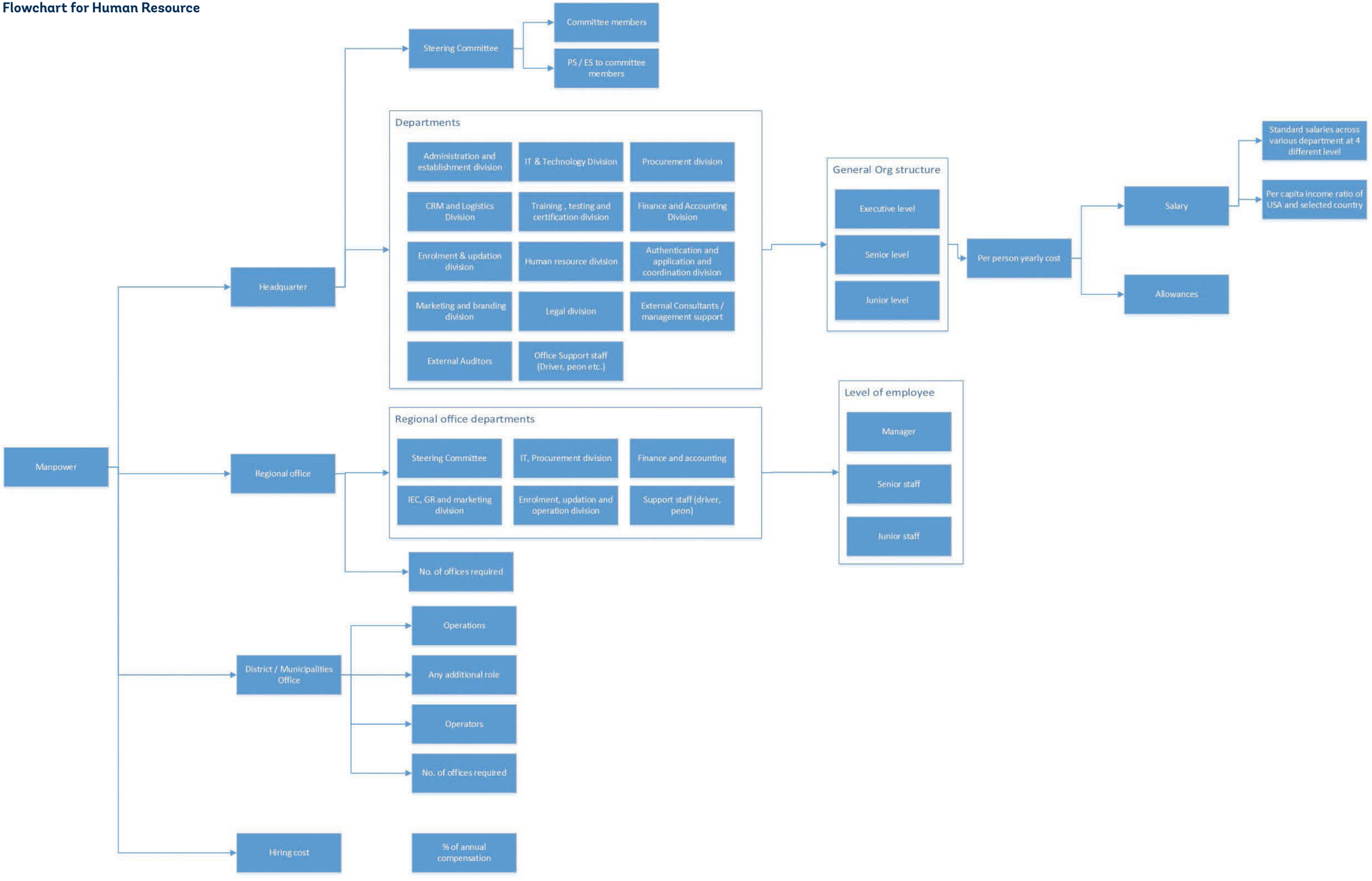


Figure 6. Flowchart for Central IT Infrastructure

Figure 7. Flowchart for Identity Credential

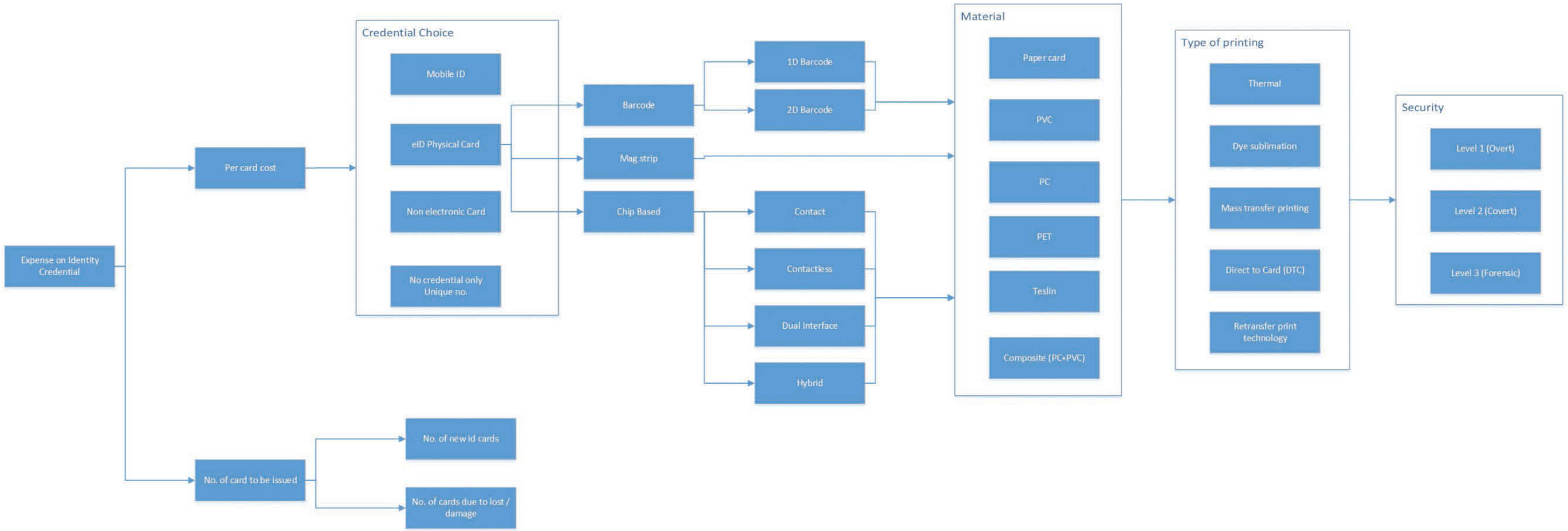


Figure 8. Flowchart for Facility Cost

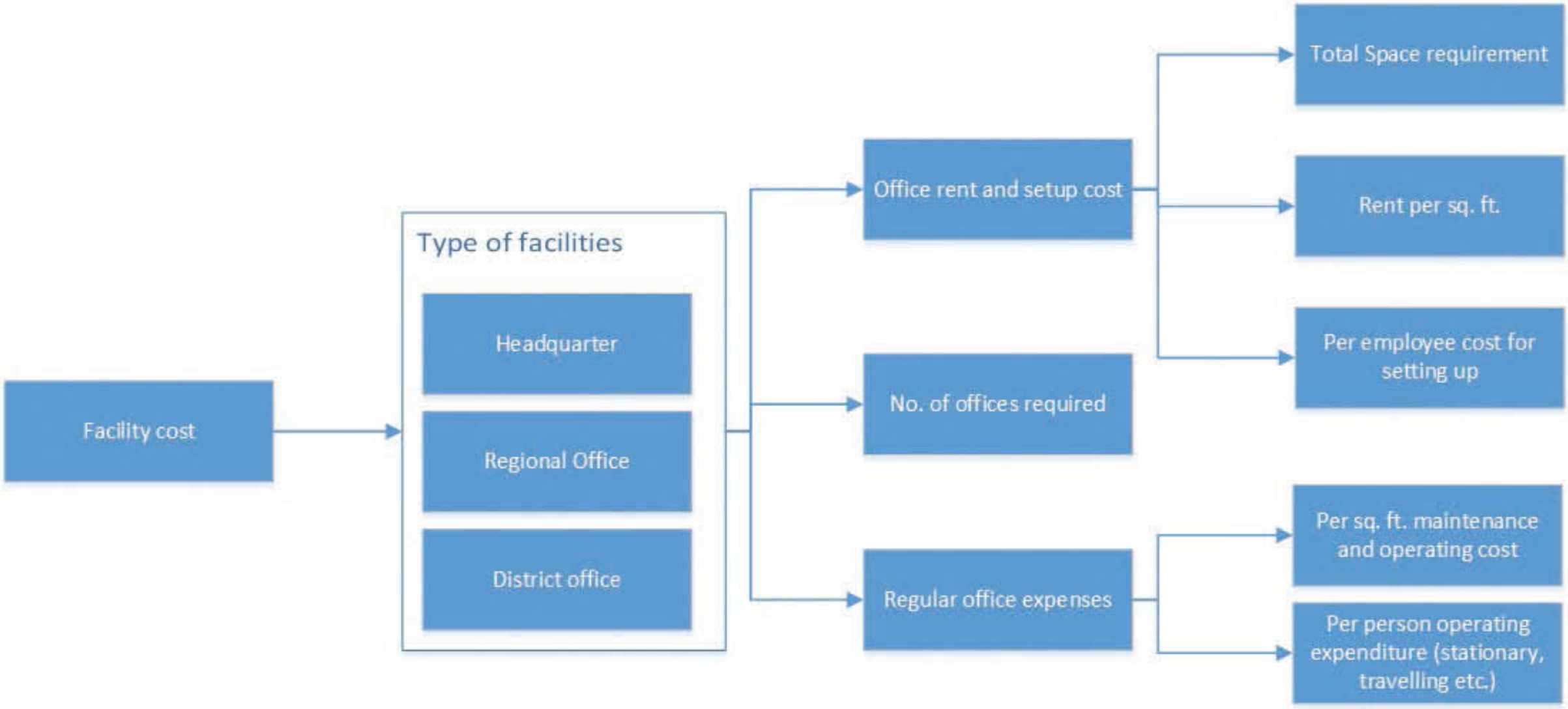
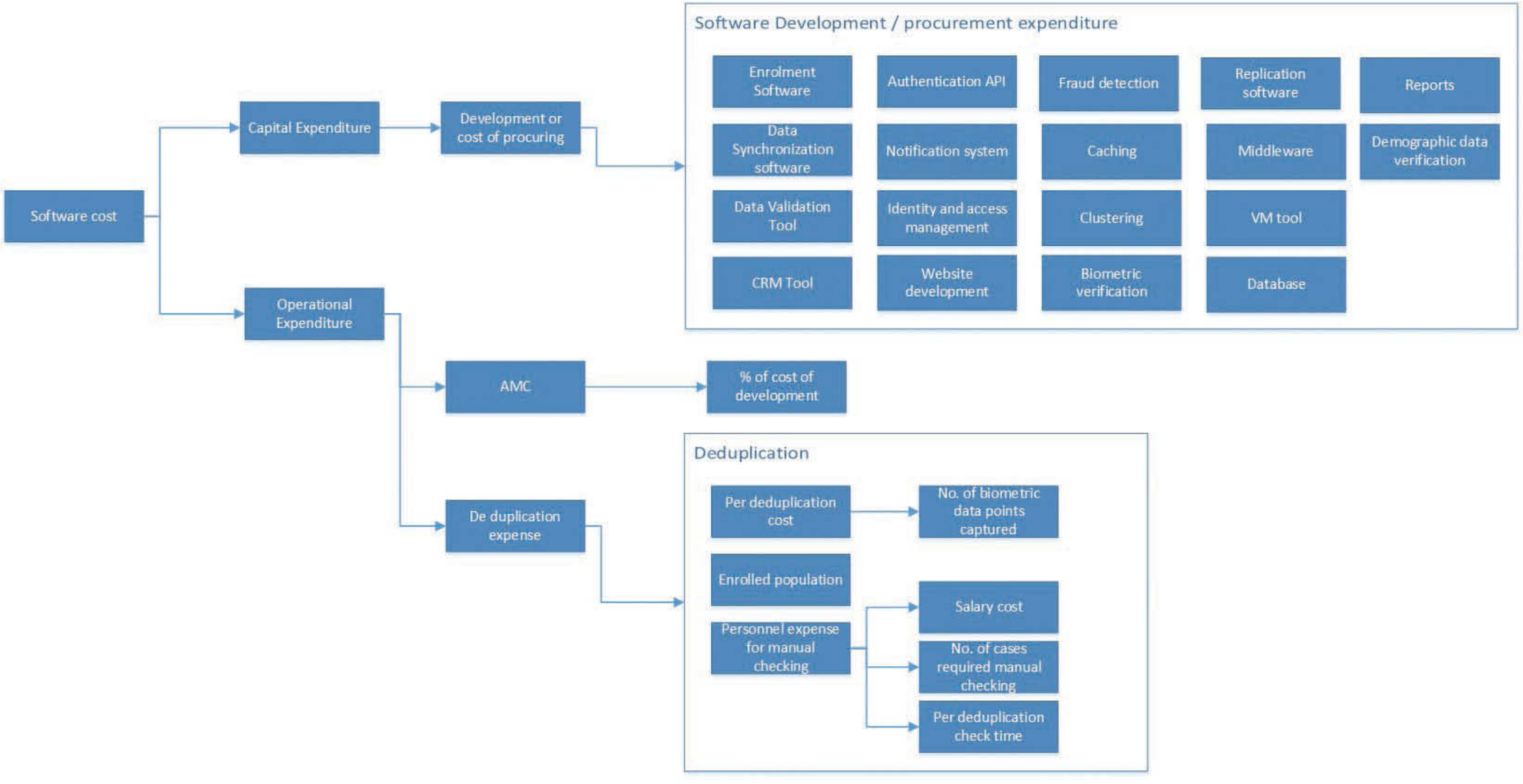


Figure 9. Flowchart for Software



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