

CIVIL REGISTRATION & VITAL STATISTICS



MINISTRY OF PLANNING
DEVELOPMENT AND
SPECIAL INITIATIVES



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Scope

The final report provides combined insights from the Live Birth Registration workflows to what kind of technology for data gathering of all other Vital Events could be used, in order to form the basis for a sustainable future CRVS. Specific focus was put at the Birth Registration workflows, processes and procedures currently in place in Pakistan, and how those could be amended and extended with Digital Technologies, either being tested already (such as the DBR Apps and Backend) or being under development (such as NADRA-Web).

Broader context

Aside from the Terms of Reference covering the ICT landscape, other consultants and work-packages assessed the Legal Framework as well as the human capacity and skillsets as well as the administrative situation in Pakistan. This ICT centric portion is only a small aspect of CRVS and will need to be extended by further studies.

Limitations

This document and its predecessors keep in mind the “current state” of CRVS-related processes of Birth Registration and only provide technical and procedural insights into a broader future “to-be state” of CRVS ICT architecture. Many other aspects of CRVS aside from Birth Registration could be covered by such an ICT landscape, the details for gathering, processing and storage of such non-birth related events have not been elaborated to a detailed level. It remains to be said, that for a full and complete CRVS to be established and used in Pakistan, both judicial, health-care sector and public administration sources could and should be leveraged as additional Vital Event entry funnels and that the ICT architecture developed herein is tailored to be extended with such additional entry points.

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1. CRVS ICT Strategy for Pakistan – the way forward

The Government of Pakistan, its Planning Commission with the Ministry of Planning, Development and Special Initiatives as well as international partners such as UNICEF have set their sights to establish a unified Civil Registry and Vital Statistics (CRVS) system that will enable Pakistan to reach universal Birth Registration. This document summarizes the key aspects of the ICT architecture planning for such a CRVS and is framed by the work of several international consultants whose insights cover organization and human resource structure, legal frameworks and administrative processes. In the absence of a thorough Requirements Analysis leading to a full blown and detailed Requirement Specification, this document can only provide some basic insights into ICT planning and strategy for CRVS with a focus on enabling Digital Birth Registration as soon as possible and making this available throughout the country. Processes and procedures for gathering such events in a digitally amended fashion and the necessary extensions to the limited existing ICT architecture have been sketched, taking into account what the several administrative levels from Village and Union Council (UC) level up to the Province. Keeping in mind that Pakistan already has a highly secure and hence secluded and well protected National ID register in form of NADRA, their Civil Identification play a major role as consumers of validated Vital Events from the “to be state” of CRVS. It is highly recommended, that the Government of Pakistan establishes an internal budget for promoting the thorough (ICT & Business) Requirements Analysis for CRVS and then setting a five-year plan to acquire, implement, customize and operate a new CRVS within the decade.

2. Operational Approach

As with the previous documents, this Final Report followed the shared methodology and approach, with input gathered from any and all elements depicted in Figure 1.

CRVS ICT Review Report

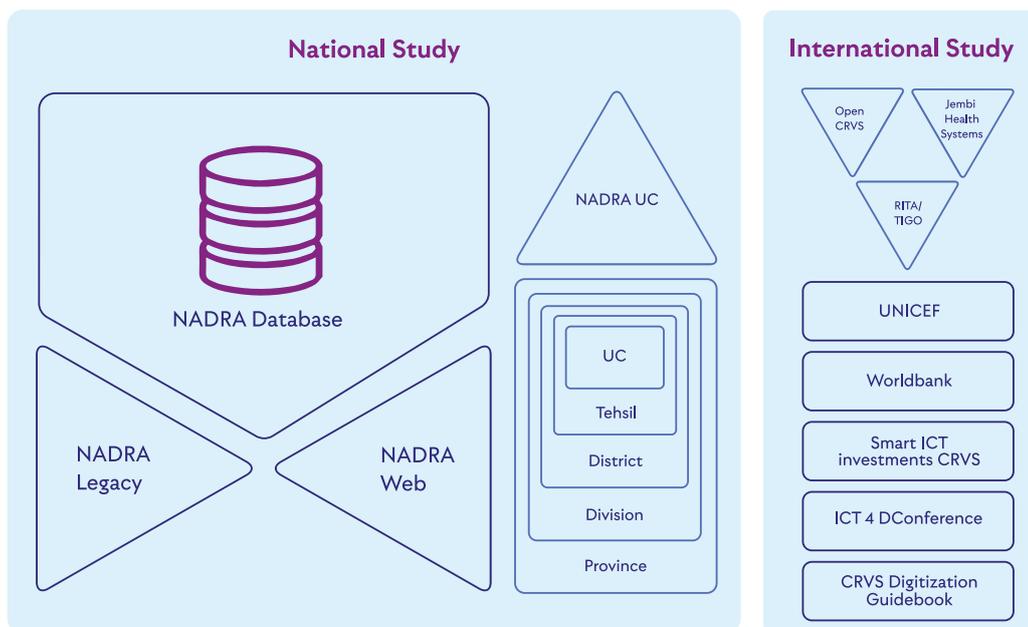


Figure 1 Overview of analysis scope and approach

2.1 Supporting Work on National and Province (Punjab) levels

Aside from the mandatory literature analysis covering not only Birth Registration, but investigating Population Health Management, across to Community School Planning and

reaching into general Vital Statistics, an outlook of the Sustainable Development Goals (SDGs) was taken. Especially the draft version of the Final Report on CRVS Framework in the Punjab Province – authored by Mia Harbitz – was taken into consideration for the “way forward” section. Earlier version were amended by detailed interviews with subject matter experts and vendor reviews as well as review of internal documentation of UNICEF efforts in similar projects.

Interviews with these experts, insights from a number of UNICEF internal studies, and a plethora of meeting minutes, presentations and papers from several Pakistani CRVS stakeholders were consumed, analyzed and reviewed. Finally – and with the highest impact – personal investigation and own studies of the author conducted together with fellow consultants during the field mission to Islamabad, Lahore and Pakpattan have been of massive importance. The personal meetings held with several organizations in Pakistan such as NADRA or Telenor, their directors, managers and individual contributors, helped to sharpen the picture of CRVS in Pakistan.

2.2 Technology Recommendation Disclaimer

In addition to the above mentioned sources, the discussion of a possible future ICT architecture and the recommendations for ICT components, development frameworks and hardware/device sections largely stem from the personal experience of the consultant as CTO of 50+ personnel ICT security Independent Software Vendor and Managing Director of 20+ ICT security consultancy. Please note, that many of the provided choices are rather meant as “technology samples” (i.e. Android based mobile phones vs. Apple iPhones; 2HE/4HE Server systems of certain make and model) and should be taken as such.

Despite of the massive effort that was put into compiling all the information about the current status of CRVS in Pakistan and its challenges, the work still is considered “very high level of abstraction” as only some core live-birth registration procedures were noted as anecdotal evidence – none of the deliverables or related work had any detailed Requirements Analysis on functional level or work item level analysis in scope. The whole work was rather targeted at finding deficiencies, clearly identifying and describing them, as to enable a future GAP analysis between a fine-granular version of the “to be state” and the actual functional requirements derived from a detailed analysis (out of scope of this ToR). The MoPD&SI and UNICEF are highly encouraged to seek multi-year funding for the CRVS strategy implementation and make the Requirements Engineering on a business and technology level a priority.

3. Summary of Findings

As per the already approved deliverables (Infrastructure Review Report, Infrastructure Manual, Assessment Report) there is a lot of CRVS related processes, procedures, forms, workflows and paper-trails available across Pakistan. Especially the field-trip to Pakpattan in Punjab Province provided extensive anecdotal evidence about how (poor numbers of) Birth Registration are handled “on paper”, and which (digital) methods and (ICT) tools are being trialed and tested by Health Professionals, Midwives and also Nikkah Registrars to improve coverage and quality. In addition to these observations “in the field”, some insight about handling National ID and ID Card issuance and master data management by NADRA were taken from their respective representatives.

3.1 Elaboration of “Work to be done”

The following subsections will elaborate on the criticality of some of the findings, first insights from the data analysis and recommendations for next steps.

- CRVS architecture and ICT planning are not “done” with this report
- A detailed Requirements Analysis must be executed to derive a full-blown Software Requirements Specification¹ based on a solid Business Requirements Specification² The work conducted under the ToR of this contract only covered a small fraction of CRVS (namely Birth Registration procedures) and the ICT architecture and component recommendations only reflect a very abstract high-level view of what technology, devices and systems could be used to build such a future architecture.
- ICT is only a small – but vital – part of CRVS; legal, organizational and process frameworks must also be considered, aside from capacity building on Village/UC level and Health sector
- Provinces and their own sub-levels of administration will benefit most from a “federated” approach to CRVS with high data quality across all levels. Aggregation of Data on National level is still mandatory, and will provide its own benefits for Ministries, Government and international aid projects – given that the data is made available and accessible to all interested parties. Hence, sharing of CRVS data is vital.
- Sharing of data both from Provincial level down to Villages but also on National level is key to reaping the benefits. National ID card data, Passport information and the likes should be kept separate and protected by NADRA – but general CRVS data on population growth, health indicators, education, causes of death (ICD-10) as well as migration data must be made available to interested parties. A Civil Registry system without a clearly regulated Vital Statistics component is futile. MoPD&SI should create a list of stakeholders and “vested interest” partners who may, should and must have access to the CRVS data on National level of aggregation and demand/right-to-access this data should be legally confirmed by laws.

3.1.1 Suggested next steps A)

As per above enumeration, the work on ICT planning and architecture and components is far from being done. The basic analysis conducted as work under this ToR only covered a small fraction of the general scope of a full CRVS, and it is recommended that the MoPD&SI issues a larger tender for the full blown analysis of end-to-end requirements in which the different stakeholders for CRVS in Pakistan can provide their insights and demand for data (data sinks), possibilities to provide data (data sources) and requirements (or means) to process and analyze data. Following this “scope setting analysis”, the next step for deriving a fine-granular view needs to be executed.

3.1.2 Pending Work on Requirements B)

As per the links provided above, a well-structured and thoroughly funded and organized Requirements Analysis must be conducted as part of the “Smart Implementation Planning” step shown in Figure 2 below. This will need to be executed across all layers of the Pakistan Public Administration, and will need to cover at least the following topics:

- Vital Event registration – which events can be registered or notified by which source with which parameters. Which means (digital/analog) are available, which would need to be added to support a fully digitized process.
- Vital Event gathering – what does each Province (under the assumption that Provinces manage “their” population Vital Event flow) need to prepare, provide and establish, to fully cover all Vital Events registered in their area and what is needed to securely gather, process and store this data in the Province.
- CRVS Province “operations - what does each Province need to do in order to run “their” instance of CRVS system.
- CRVS data administration - what does each Province need to prepare and build on capacity to fully support their needs to properly administer their Vital Event data.
- Provincial (and local). CRVS data analysis - what does each Province and their subordinate levels of administration need with regard to local Data Analysis and “Vital Statistics” – which functionality will be required.
- National level CRVS data analysis – which National level stakeholders have a vested interest in the CRVS data analysis, what are those needs and how can they be served.
- CRVS development – as a federated system architecture based on “functionally customized Provincial System instances” connected to a standardized National level CRVS Database backend is recommended: where, how and by whom will the development of the base system be managed and how will it be funded.

3.1.3 ICT as CRVS enabler C)

As per the common CRVS Digitization Guidelines and as displayed in Figure 2, the implementation of ICT components can only build on smart project governance and strict guidance and joint planning, as to what needs to be built from scratch and which components can be re-used or re-purposed. As per Section 3.2 above, it is recommended that the requirements analysis is combined with an activity that identifies any eGovernment/ICT initiatives around Health, Statistics, ID documents as well as Education and Development to be analyzed for possible synergies and re-use of components that are either needed or provided/planned by each other. This can have tremendous benefit on the “Smart implementation planning” part of the cycle.

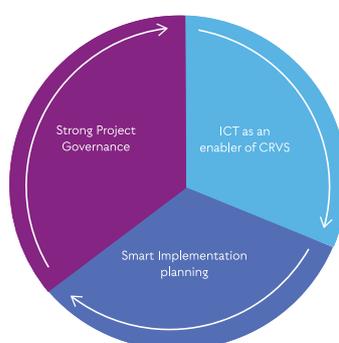


Figure 2 The three Key Principles

3.1.4 Provincial Influence and Impact D)

As with NADRA, there already is a national level organization which handles National ID number, ID cards and Passports and issues registration certificates based on their own infrastructure, there needs to be a clear differentiation between the scope and tasks to be executed by NADRA and those where the Provinces and/or any non-NADRA government stakeholders have their own needs and requirements for Civil Registration functionality (aka: legal requirement to provide means for Birth Registration and to issue Birth Certificates).

Hence, the focus of any development of CRVS should first be put into delivering benefit, positive impact and assistance to those parts of the Government hierarchy that are tasked with creating the data entries: Village and Union Councils. Their requirements on making it easier to register Vital Events and gather them for future analysis are penultimate. After those, the different regional analytics i.e. for planning education/schools, medical facilities or calculating emergency relief help in case of disaster need to be considered.

The focus on Provincial needs also must reflect the deviations they might have due to presence of ethnic minorities or special migration-related challenges. Here, the Requirements Analysis must be tailored to the Provincial exceptions beforehand.

3.1.5 Equal and unhindered access to Vital Statistics Data E)

Last but not the least, the CRVS system provides a plethora of possible use-cases and analytical options, which may enable unprecedented quality in planning and highly increased efficiency of many governmental and administrative tasks. Yet, the organizations, ministries, agencies and institutes on Pakistan national level may be dwarfed as potential stakeholders once private companies and international aid and development organizations may request access to certain portions of the CRVS database. It will be a set of complex tasks to determine which type of organization or entity may request access to which part of the database based on public interest, commercial interest or legal obligation. There is potential to re-finance part of the cost of the whole CRVS system by determining which dataset may be dubbed "marketable" to third parties for fee, without sacrificing data protection and data privacy rights of individuals. As an example, the completely anonymized information about population growth in certain areas may be marketed to Mobile Phone Operators or other Infrastructure Services providers to improve their investment planning with regard to capacity and density of Mobile Phone base-stations and antennae distribution.

To enable such business models, a balanced set of access control rules and policies need to be defined by the government body leading the implementation and operations of the Federal/National part of the CRVS. Provinces may define their own rules and regulations as well as access controls for their own datasets and their own needs.

3.2 Defining the Goals and Setting the Scope

ICT in itself cannot solve the issue of low Birth Registration rates in Pakistan. The decision makers inside the MoPD&SI and the Government Officials in the various layers of the Pakistani Government must define swiftly, what CRVS in Pakistan should provide and how ICT can be used to enable any of these goals. This includes the business functions and processes of CRVS. The following questions and suggested options had been provided in previous deliverables to spark the internal discussion.

3.2.1 Analyze the specific Pakistani business needs for CRVS

- Main objectives to be achieved by establishing a new & improved CRVS in Pakistan?
 - Achieve universal birth registration before the self-set timeline
 - Improve data quality of registered Vital Events
 - Streamline gathering and processing of Vital Events

- Make Civil Registry data available for analysis on different layers of government
- Make combined CR data available to statistical analysis beyond the NADRA scope
- Core processes and procedures needed to achieve these objectives
 - Notification about and registration of Vital Events, even in the most remote areas
 - Pushing the boundaries of Digital Processing of such Vital Events to villages and UCs
 - Providing paper audit trails for non-digital event registration (unique form serial number)
 - Connect serial number of paper forms with digital evidence
- Administrative tasks to be executed to achieve these objectives
 - Engage different sources of Vital Events to contribute to CRVS agenda
- Provide well-defined, standardized and well-documented administrative tasks
- Address the confusion with regard to Birth Certificates and NADRA Child Registration Certificates
- Provide clarification and definition of clear boundaries of responsibilities and accountabilities
 - Provide precise and binding planning, on how and until when this standardization and documentation will happen and means and budget to do so on all levels of administration
 - Adapt an "Enterprise Architecture" (EA) methodology to align the (specific Pakistani) business need to the underlying ICT architecture
 - Adapt the simplified and easy-to-use formats delivered via the www.crvs-dgb.org
 - Use core chapters of the "CRVS Digitization Guidebook" to plan deployment
 - Make sure to address and implement all core components of the CRVS business domains

3.2.2 Elaboration of "Work to be done"

Figure 3 shows, how closely intertwined Civil Registration and Vital Statistics are with the Health Sector and the Civil Identification (NADRA) components. It becomes obvious, that the Vital Statistics part is pretty much independent from the Civil Identification part, but Civil Registration takes center stage with extensive data exchange happening between Health Sector (as a source of Vital Events for CR), VS as a target (data sink) for any and all aggregated and confirmed amalgamation of CR data and Civil Identification as a "full-duplex" data exchange partner, both for providing updated CR data to CI, but also for proofing and validation of event attributes by CR from the most trusted and protected CI data.

Finally, Civil Identification and Civil Registration are very closely related and share large datasets, hence depicted with a bi-directional arrow. Here, it should become obvious that a future CRVS/CI integration will need to provide means for bi-directional data exchange. As the focus of analysis of the work covered by the ToR was with Birth Registration procedures and streamlining these, Vital Statistics and its integration interfaces have not been covered and need to be analyzed by Pakistani resources.

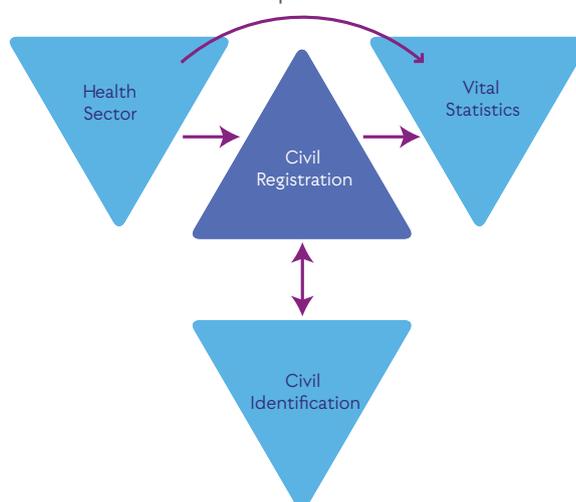


Figure 3 CRVS, Identification and Health

3.3 Results Summary of D2 Infrastructure Review

The Infrastructure Report presented a closer look into the current state of Pakistan Civil Registry and Vital Statistics with a focus on Birth Registration, especially the recent innovations brought through piloting “Digital Birth Registration” technology in certain regions.

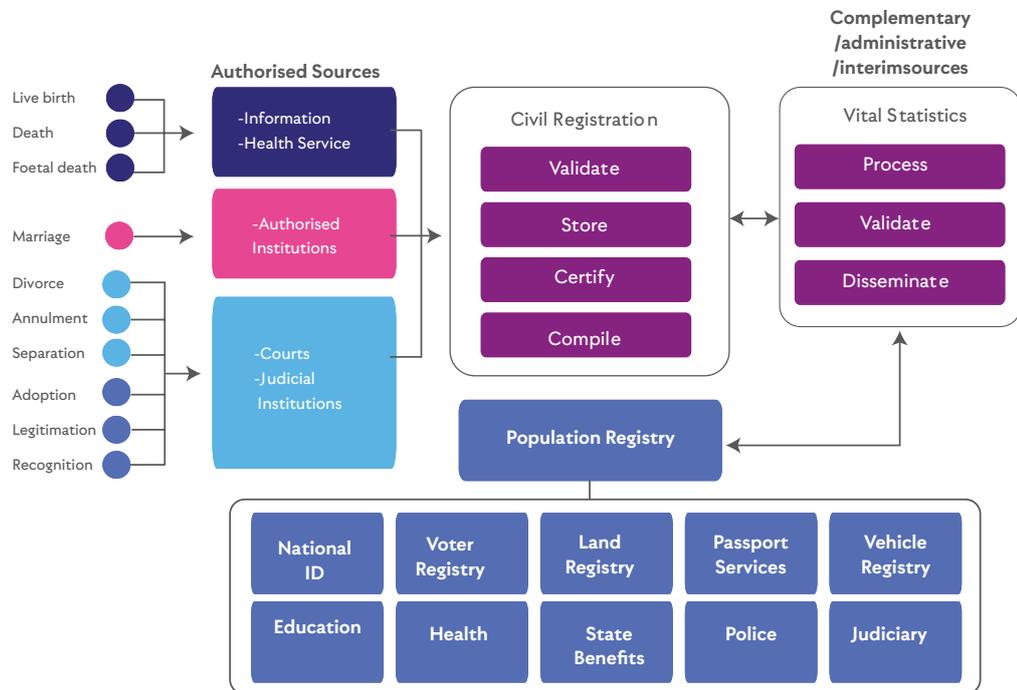


Figure 4 CRVS Business Domains as per CRVS Digitization Handbook (as seen on <http://www.crvs-dgb.org/en/>)

The above Figure 4 was taken as orientation for the analysis and is suggested as possible frame for any discussion around the possible scope of CVRS in Pakistan, as it clearly mentions all common sources for Vital Events and their respective facilitators as well as the core functionalities that any Civil Registration needs to fulfill: Validation – Storage – Certification – Compilation. Only with these in place, a proper analysis of the CR data inside any Vital Statistics components could be achieved, which in turn need to cover the most basic VS functions such as: Processing of Datasets, Validation and Dissemination to stakeholders and parties of interest.

Any other governmental or public service related to CRVS such as Population Registers and their derivatives (namely all services NADRA provides). could be served by tapping into the vast potential the complete and universal Birth Registration could bring to CRVS in Pakistan.

Armed with these generally accepted international cornerstones, the document elaborates on the situation in Pakistan from the National level right down to the Union Councils (UC).

3.3.1 Main insights

From the anecdotal evidence gathered during the field trip to Pakpattan in the Punjab Province, the situation in rural areas of the country are still dominated by book keeping approach, where the local Nikkah Registrar manually transcribes information from paper forms filled by parents or legal guardians of children and visually validates the data provided by inspection of paper copies and originals of National ID cards provided by the notifying individual. The datasets gathered in paper form later need to be typed into the desktop based NADRA application by the local registry officer. The process is assumed to look similar in most other regions and provinces in Pakistan and was visualized as presented in the following Figure 5.

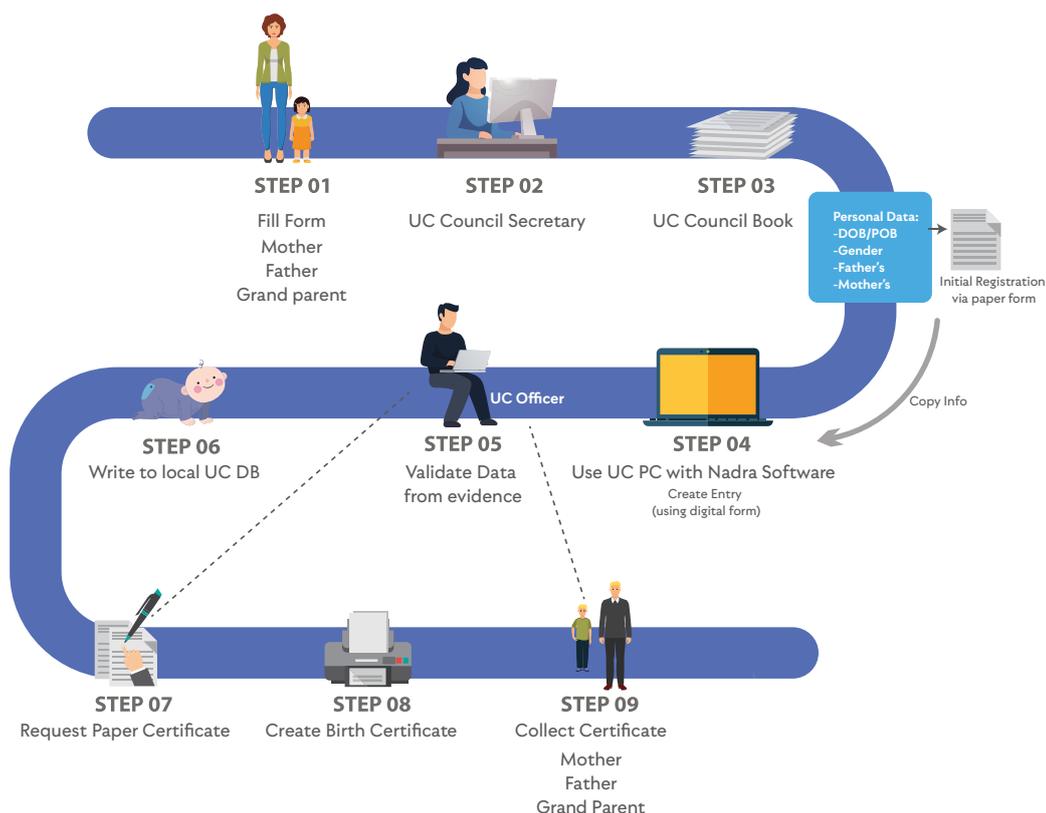


Figure 5 Current paper-based process flow

Aside from this workflow view, the technology assessment showed the following:

- Most UC/Tehsil officials use a HW/SW bundle provided by NADRA
- Data entry, processing and storage is decentralized (held locally)
- Matching peripherals such as printers have been issued to assist certificate issuance
- Birth Certificates can be issued locally by printing on Secure Paper provided by NADRA
- Birth Registration requires National ID provided by NADRA in separate offices
- NADRA also issues "Registration Certificates" to parents upon signing up
- ICT Security analysis of situation identified some areas of improvement during the field trips, some of which have been addressed recently by innovation like "Digital Birth Registration" (DBR) project, a Public-Private Partnership supported by Telenor Pakistan and UNICEF.

3.3.2 Digital Birth Registration Project

The DBR project is a joint effort between the Punjab Local Government and community development NADRA, as well as the Ministry of Planning Development & Special Initiatives plus the Health, Social Welfare and Education sectors as per Figure 6 DBR Collaboration Punjab.

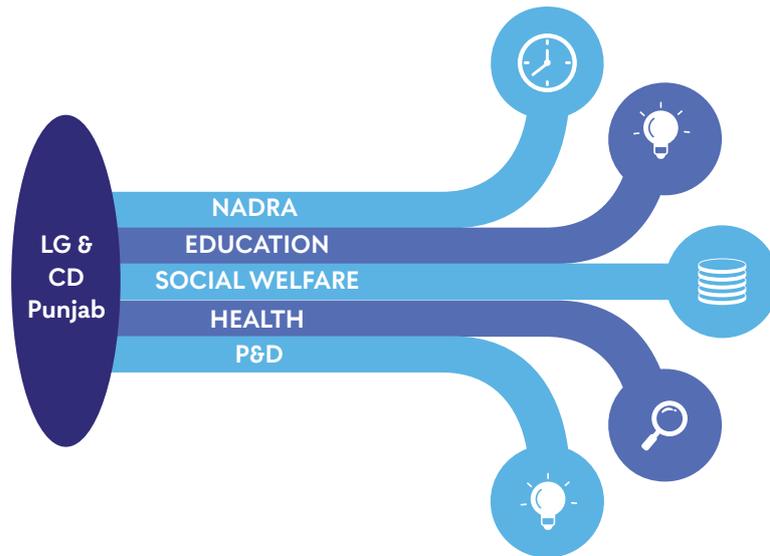


Figure 6 DBR Collaboration Punjab

As part of reaching and promoting the Sustainable Development Goals (SDG), UNICEF has been working with the Departments of Local Government and Health, the National Data Base Registration Authority (NADRA) and the mobile telecom network operator Telenor to improve registration of children in several areas of Pakistan, covering a total of nine districts in Punjab and Sindh provinces. Aside from registering Births, DBR outcomes should also provide or improve several other aspects of the CRVS landscape, as per Figure 7 DBR Projected Outcomes

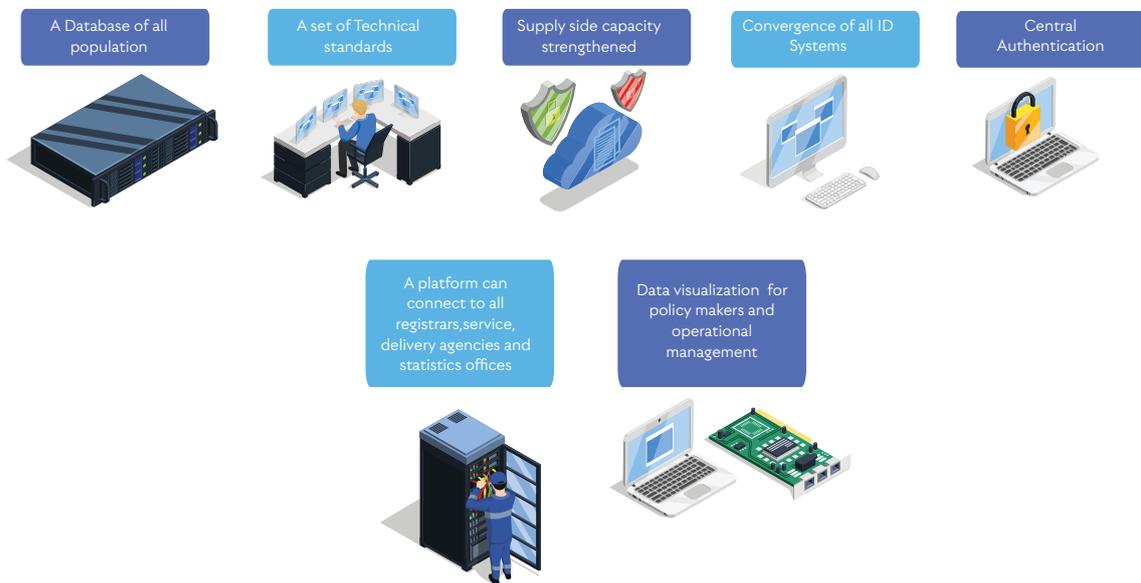


Figure 7 DBR Projected Outcomes

3.3.3 Digital Birth Registration Approach and Technology

To facilitate the process of registering live birth events and promote the adoption of a digital process in doing so, Telenor created an info-graphic that describes the intended flow (see Figure 8).



Figure 8 Schematic view of DBR steps for Child Registration

The whole process is of filling forms, validating entries and transcribing these into an ICT system is reduced some simple steps all executed by using a smartphone or tablet, as visualized in Figure 9. Especially the complex and costly provisioning of paper evidence such as copies of National ID cards of the parents is simplified into snapping photos of the cards with the App during data gathering.

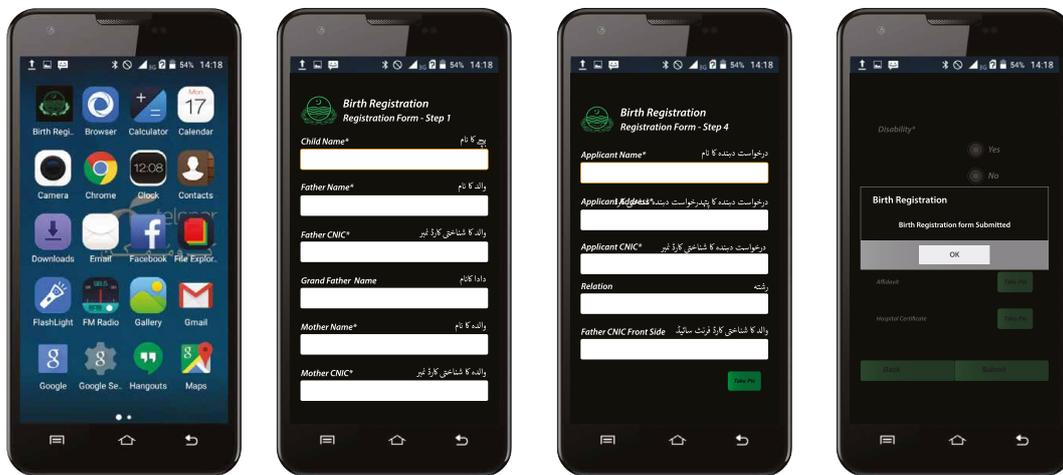


Figure 9 DBR Mobile APP

The simple and straight forward User Interface with bi-lingual support is a huge improvement over the tedious and time-consuming manual paperwork that Nikkah Registrars have to walk through without DBR support.

In addition to significantly improving the workload situation for the Nikkah Registrars, massive projected benefits are assumed for the work of local Provincials, Division, District and Tehsil administration as they are able to consume the statistical data gathered by the system with minimal effort. Already the sample screenshots of the Statistical Analysis dashboard as per Figure 10 show that massive positive impact could be created for all kinds of administrative planning, distribution or social aid activities that need to be executed on several levels of the Pakistan government.

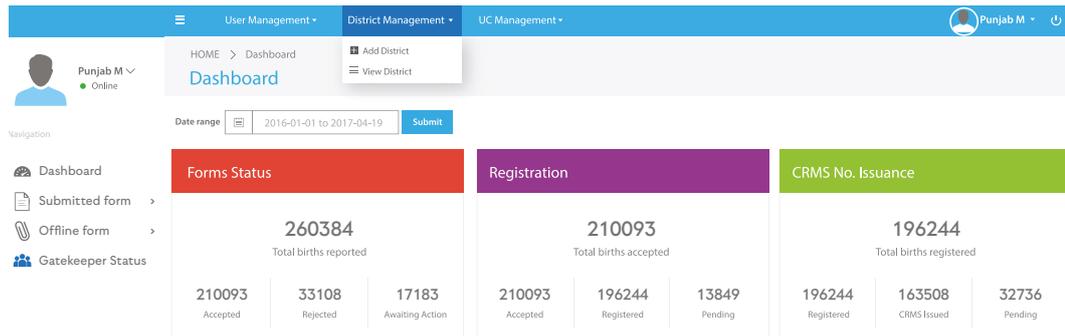


Figure 10 DBR Statistical Analysis Dashboard

Finally, the “mobilized and digitized” workflows introduced in the DBR pilots were analyzed. The Figure 11 on the next page shows how much more simplified the notification of a live birth becomes after adoption of DBR, in comparison to the rather complex and overly burdened full paper based process seen in Figure 5 above. It can only be commended how much work and effort went into developing the DBR technology stack and some of the core functional modules should be evaluated for adoption into a future Pakistani CRVS by re-factoring the code into a scalable and “production ready” platform based on easy-to-manage so-called containers.

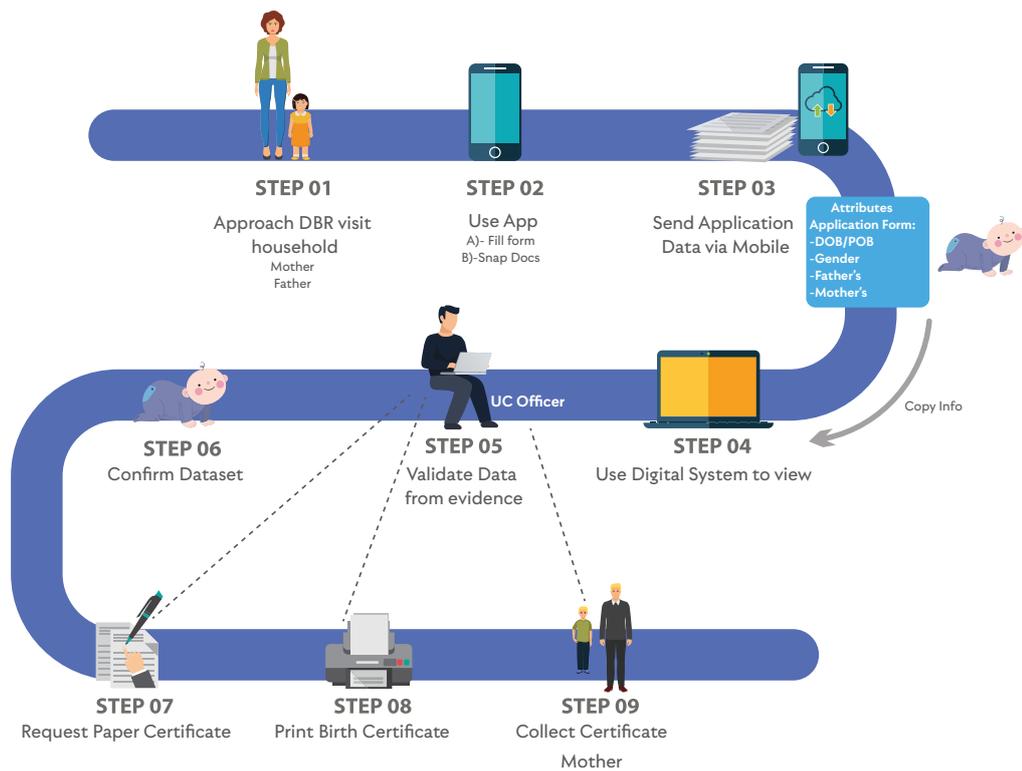


Figure 11 DBR Process Flow

3.3.4 NADRA

The National Database and Registration Authority (NADRA) with its 800 offices across the country has established itself as single source and institution to apply for and acquire computerized national identity cards (CNICs) – which is mandatory for each citizen upon his/her 18th birthday. A unique 13-digit number is supposed to be assigned to a child at birth (when the parents complete the child’s birth registration form “Form RG-2”, commonly known as B-Form or Child Registration Certificate (CRC)) – this was shown to lead to some

confusion as indicated by anecdotal evidence gathered by the consultants, as some parents fail to tell apart the NADRA issued CRC from a Birth Certificate (BC). As these BCs are issued by the UCs with their non-centralized system at an additional cost and some parents assume that "a CRC is enough", there is situation of perceived competition between obligatory collection of a CRC and the "optional" acquisition of a Birth Certificate.

The perceived competition is further enforced by the deployment of NADRA Web – a new application stack based on modern Web-based technologies which would allow NADRA representatives to use an online system to gather personal data, validate the entries and issue ID card requests in much accelerated fashion. NADRA utilizes the data gathered by UCs and the Nikkah Registrars by collecting the locally gathered and stored Birth Registration and BC issuance data entries and consolidating them into their core database. While this is a comprehensible work process for an agency tasked with creating a National Database and Registration Authority.

3.3.5 Architecture Recommendations

In June 2019, a rather abstract and high-level future CRVS architecture within a similarly abstract broader landscape was provided.

Interestingly, a strong separation of the NADRA infrastructure and its services was already recommended at this early stage, clearly setting apart the data gathering, aggregation and data analysis functionality on Province and National levels from the Civil Identification functions provided by NADRA. As per the central "API Gateway" component, all parties and institutions with a vested interest in Statistical Data from the CRVS should get their protected and secured access to those datasets and subsets of information that they have a proven interest and "need to know" in.

As with the current (January 2020) recommendation, data gathering, and local analysis should be operated under the authority of each Province in their own datacenter and their own instances of the federated CRVS system. This allows for full data sovereignty on the local/regional datasets and its statistical analysis as well as cross-divisional/cross-regional comparison of data without the need for accessing the national database.

3.3.6 Further Insights of Infrastructure Review Report

Despite its early creation data, Infrastructure Review Report also contains a considerable amount of information on:

- possible breakdown of architectural ICT components of Pakistani CRVS
- (data) interfaces between those components
- intermediate systems needed (or suggested) to make a "federated CRVS" possible
- description of "personas" or acting persons as required by any regular Requirement

Specification in a standards-bases Requirements Analysis process (suggested in this report)

3.4 Results Summary of Infrastructure Manual

The Infrastructure Manual sets its focus on defining the technological cornerstones of a future digitized CRVS system with a focus on enabling swift and complete Live Birth notification and registration. Therefore, the author re-iterated the possible new digital and still necessary old analogue channels (see Figure 13 Overview of Entry Channels for Vital Events). The digital channels mainly being built up based on varieties of the DBR App and its backend functionality, enhanced with some Desktop/Browser based User Interfaces for easier Data Entry and Data Validation. While digital channels are to be preferred, maintaining a solid paper-based analogue workflow as a fallback mechanism has proven mandatory for offline and ICT failure scenarios.

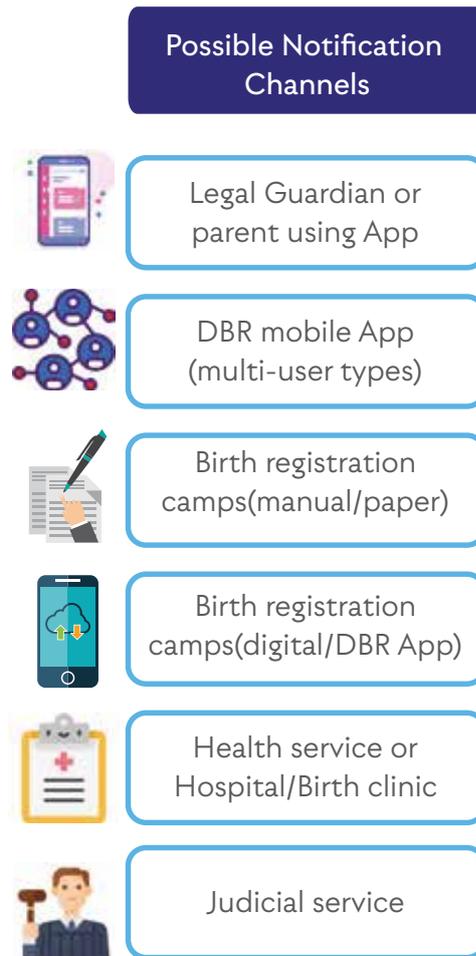


Figure 12 Overview of Entry Channels for Vital Events

The different sources (aka "entry-points") for Vital Events which are necessary to fill a meaningful CRVS database may be relying on different technology types, to make most out of the situation and the already existing infrastructure. The following Figure 14 Overview of Entry Channels for Vital Events provides an overview of possible channels of Vital Event notification/ registration and are by no means mandatory or obligatory. They rather indicate opportunities for adding new sources.

	Entry points	IT Hardware needs	IT Software needs
	Legal Guardian or parent using App	Android 3G/4G Phone or Tablet	DBR,Parent"App Mobile Browser"
	DBR mobile App (multi-user types)	Android Mobile Phone Mobile phone 3G net	DBR mobile App (multi-user types)
	Birth registration camps(manual/paper)	Landline connected standard office PC	Standard Web Browser (Chrome/Firefox)
	Birth registration camps(digital/DBR App)	Android Mobile Phone Mobile phone 3G net	DBR mobile App (Nikkah-user type)
	Health service or Hospital/Birth clinic	Landline office PC or tablet 3G/4G	Standard Web Browser or DBR Health-App
	Lady health worker	Android Mobile Phone Mobile phone 3G net	DBR mobile App (LHW-user type)

Figure 13 Overview of Entry Channels for Vital Events

Aside from the extensive coverage of possible channels and their respective technological type in sections 3.2 of Infrastructure Manual, it is highly recommended to seek further integration with the Health Services sector and any kind of medical practitioner, be it Midwives, Nurses, Doctors or Community Health Services personnel. They should be a focus group for adding new entry points for CRVS Vital Event data, as evidence from across the globe and especially from African countries show tremendous success in following that path.

3.4.1 Gathering data from and using it on Province level down to the UC and Villages

One of the major insights of the Infrastructure Manual analysis was with identifying the several layers of Pakistan Administration as both providers (sources) of Vital Event data and at the same time consumers of Vital Statistics for a multitude of use-cases from different levels, down from the Province level right to Union Councils and even the villages.

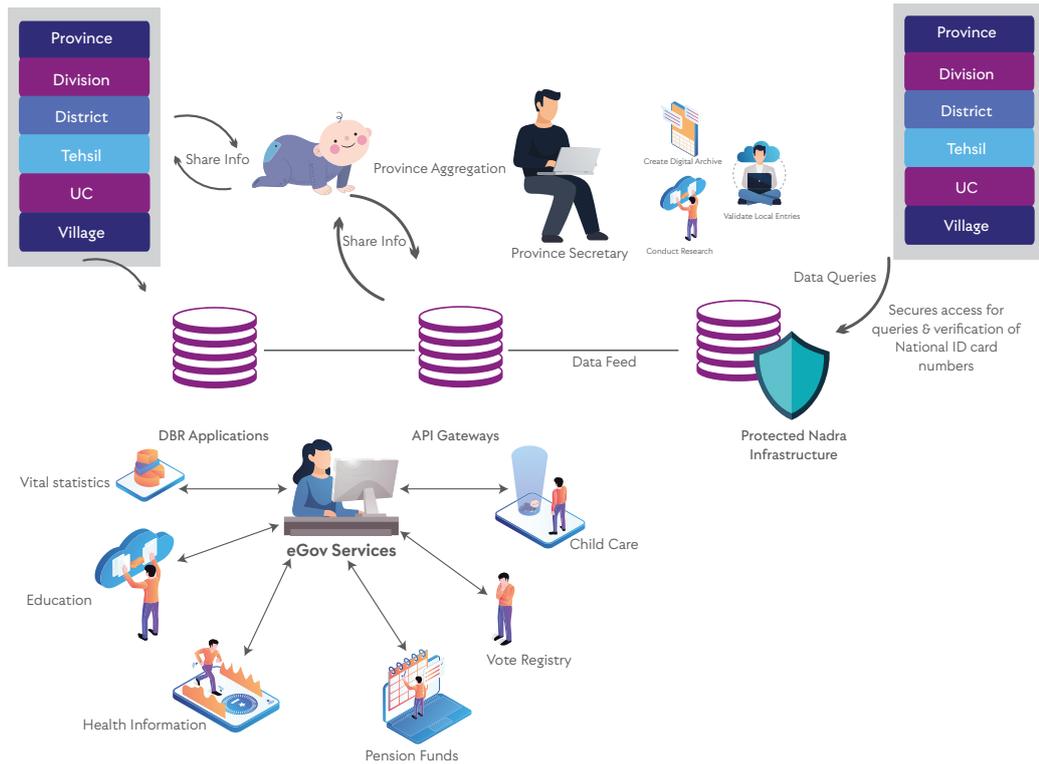


Figure 14 Overall national level data aggregation and usage

Not only tapping all possible kinds of VE information from all kinds of sources, but also being able to gather, cross-reference and analyze that data locally inside the Province and its sub-levels will be a dramatic improvement for all government officials and administrative officers working on planning activities related to education, health, agriculture, subsidies, emergency relief etc. Even such critical tasks as Voter Registry updates and maintenance of immunization level for contractable diseases will benefit from such local data being made readily available to possible users.

These use-cases are a main reason for creating a federated type of CRVS system in Pakistan, in which each Province runs, maintains and customizes its own flavor of CRVS while keeping the underlying Database all interoperable and ready to merge with other Province’s data on the national level. Such an approach enables the Provinces to scope and tailor their specific CRVS frontend and functionality to their respective needs and keep all means and methods of customization and extension of the user interface in their hands while maintaining interoperability with the National Database.

3.4.2 Aggregating data from Provinces to National level

The overall consolidation of CRVS datasets should be based on a unified, compatible and interoperable set of Provincial ICT systems, that all manage their respective data and sync the individual datasets into the national level system, as per Figure 16. As can be seen, each Province may establish, run and maintain their own Provincial Registry Core (DBR) system, which only sync the fully validated Vital Event datasets to the nation level CRVS database. With this approach, all Provinces are able to gather their own data according to their own needs with special attributes as required per local legislation, while the standardized attribute datasets are being forwarded to central DB. This will ensure, that also local regional or District level analysis, planning or health initiatives can be fulfilled without administrative overhead and burden from National Level institutions, while those National institutions still get access to highest quality aggregated CRVS data.

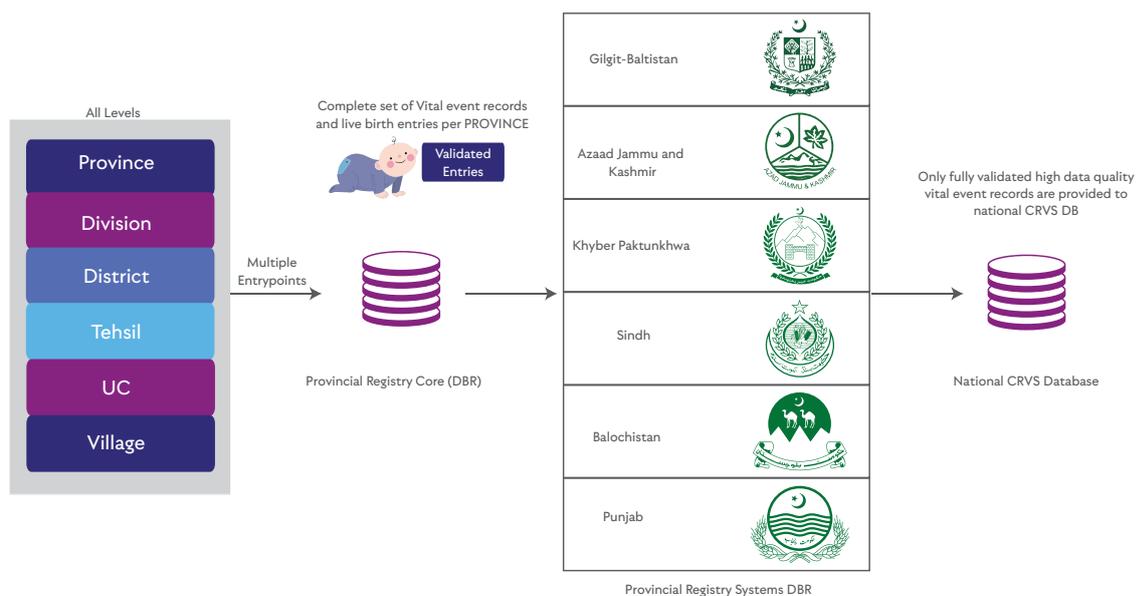


Figure 15 Data Aggregation Province to National Level

3.4.3 Technology Aspects

As per the previous sections, a main barrier to “going digital” is the lack of proper devices and infrastructures to digitize CRVS.

Infrastructure Manual elaborates on possible devices to execute the “production ready” DBR app and its backend technologies, suggesting – but not limiting – the choice to the following devices:

Tablets

Possible device choices (November 2019) include but are not limited to

- Huawei Mediapad M5 lite
- Samsung Galaxy Tab A 10.1 T510
- Lenovo Tab P10
- And many others

Mobile Phones

Possible device choices (November 2019) include but are not limited to

- XIAMO Redmi 7/8
- Samsung Galaxy A30 and above
- Honor 8x
- HTC Desire 19+
- and many more

Laptops

Any kind of laptop computer with:

- screen size of 12” (minimum) and above
- screen resolution of 800 x 1280 (minimum) and above
- 2.x GHz multicore Intel CPU (i5 minimum) or similarly specified AMD or 3rd party CPU

- 8 GB of internal memory
- 120 GB of HD/SSD memory
- Arbitrary Operating System (Windows 10 recommended, Mac OS, Linux, Chrome possible)
- WIFI or 3G (and higher) – optional RJ45 network cable socket
- Standardized browser technology such as Chrome or Firefox in the current version

Servers

Basic machine specifications which should serve as the “Minimum Standard”:

- 19” Rack Mount Server devices of 2 HE design
- At least 2,5 GHz CPU with at least 10 cores – Multi CPUs-slot systems preferred
- At least 32 GB RAM – 64 GB recommended

A possible variety would be

- HP Proliant DL380 Gen10 SFF 2U

3.5 Results Summary of CRVS Comprehensive Assessment Report

The above-mentioned Hardware Specifications can only be taken as a rough estimate, without any Requirement Specification of the functionality being available yet – hence, the whole set of recommendation should be seen as navigation markers for setting a budget for a future CRVS. Aside from the hardware devices needed to execute any tasks, a number of software components need to be considered as well. Therefore, the Figure 17 Protocols and Technologies, provides an overview of the components in a “highest level of abstraction” mode.

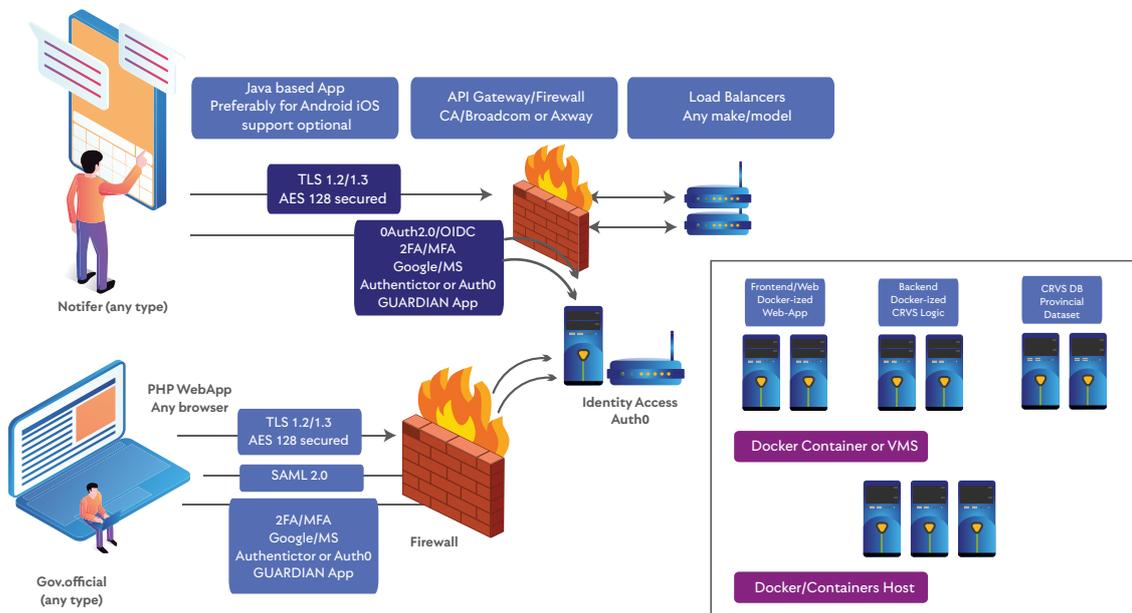


Figure 16 Protocols and Technologies

Operating System of the CRVS could be either RedHat Enterprise Linux or the similar Centos distribution. Ubuntu seems to be a viable alternative, but with regard to Docker Container Management, RedHat can offer OpenShift which is a powerful Kubernetes Container Platform.

3.5.1 Component Technology Overview

	Endpoint (Mobile)	Endpoint (PC/Mac)	Gateway Firewall	Identity Access	MFA 2FA	Frontend	Backend	Database	Container
Preferred	 	 	 			 			 
Optional	 	 	 						

Figure 17 Technologies Suggestions

Taken from the sub-sections of Assessment Report, the above Figure 18 shows the suggested technologies to be taken as possible path forward. From the point of view of the author, these are only recommendations, and may be superseded by any local decision influenced by availability of personnel and proficiency of local workforce with respective technologies.

3.5.2 Security Overview

As highlighted in several sections of previous deliverables, the topic of Information Security and Data Privacy need to be well addressed within CRVS, as possible abuse and misuse of the system itself and the data stored therein may lead to unwanted civil unrest and even international reprimands.

In general, it needs be assured that the core security goals of Confidentiality, Integrity and Authenticity as well as Availability are met by the core CRVS components and its sub-components and extensions. Especially the distributed nature of the ICT architecture suggested within Assessment Report and the Work Plan through Infrastructure Manual have shown, that a “per Province” approach to gathering and managing Vital Events is the way forward, hence making local investments into ICT security a must.

Confidentiality: the sensitive personal information (PI) and personally identifiable information (PII) of all Pakistani citizens stored inside the components of the CRVS need to be protected against unwanted disclosure and abuse by third parties. As a rule of thumb, all data interfaces, all data communications and all data storage needs to be encrypted in such a way, that only individuals with a “need to do” and “need to know” may access any data within the limits of the CRVS as a whole.

Hence it is recommended by the author to implement the CRVS system with encryption technology activated for:

- **Data at Rest:** all personal information data stored inside the Database must be encrypted by activating the “Transparent Data Encryption (TDE)” of MariaDB4 and make sure key management is defined properly 5
- **Data in Motion/Transit:** the database connectivity 6, as well as the web-traffic and API access must all be secured with TLS 1.3 (or at least TLS 1.2) with current algorithms for encryption
- **Data in Processing:** any analytics options in the Vital Statistics part should be carefully scoped in order to prevent personal information about individuals from being leaked.

Integrity:

Only data that remains valid, up-to-date and correct will assist the Pakistan National Administration and the different layers of Administrations from the Province down to the Village level in planning their projects by providing meaningful statistical data to the

Government Officials. Hence it is mandatory, that the data gathered is correct, valid and trustworthy – all of which can only be safeguarded by implementing strict Identity & Access Management policies and enforcing them with a tight management of entitlements for all personnel tasked with accessing or maintaining any CRVS data stored in the system. A decent and proper Role Model with the necessary roles and responsibilities from data gathering across data analysis to system and database admins needs to be developed and their respective access rights need to be defined. Especially mass-changes or updates to multiple datasets at one time need to be conducted under close surveillance and only with adequate means of rolling back any of these changes if erroneous causes are identified after such changes are committed. Data input sanitization is another topic of high relevance to ensure that only valid datasets are entered into the system and no contradicting data is being processed.

Availability:

While it may be acceptable that either CRVS data entry or CRVS data analysis functionality may not be available at given point in time, the availability requirements for the core database and its Provincial counterparts must be defined and documented in detail. Taken from anecdotal evidence and using indicators from i.e. African continent examples, an availability target for the core Database of 99.99 % across the whole year is deemed sufficient, while local Province systems should target at 99.9 % overall system availability for analysis tasks during business hours of workdays. As birth and other Vital Event data may be detected, gathered and provided to the Provincial system components at any time of day all days of the week, the data entry functionality should either be targeted with 99.99 % availability across the whole year or – alternatively – means for caching any event registration data during system failure should be implemented.

Deploying the Provincial CRVS components as Docker Containers and making these available in “high availability configuration” per Province should be a high priority. This includes making the systems reachable by using at least two different access lines to the Data Center provided by two different carriers, and having the cables enter the building where the Data Center is located from different sides in order to prevent any construction work interfering with connectivity.

For further information on Security Technology Recommendations, please refer to Assessment Report.

3.5.3 Architecture planning of CRVS system

As with any architecture, the CRVS system in Pakistan should be broken down into functional building blocks at first, which can be of rather coarse granularity and need not to be defined into actual “transaction detail”. A simplistic view of such a block-diagram can be seen in Figure 19.

The necessary communication interfaces of the Frontend System (light green) are depicted as both modern JSON/REST based APIs (reddish) and classic WebApp Interface (turquoise). The actual Business Logic (green) is separated from the APIs and User Interfaces, as are the local Database (light blue) and its Validation/Synch component (petrol). Not depicted but mandatory are local security services such as Backup and Access Control.

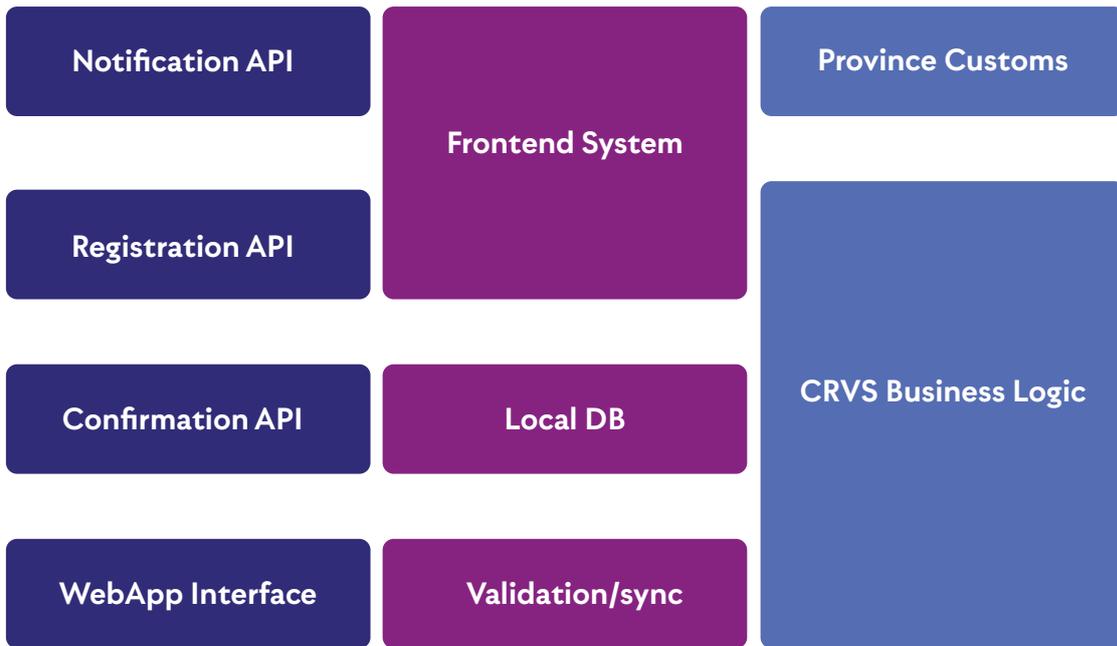


Figure 18 Block Diagram of CVRS Registry

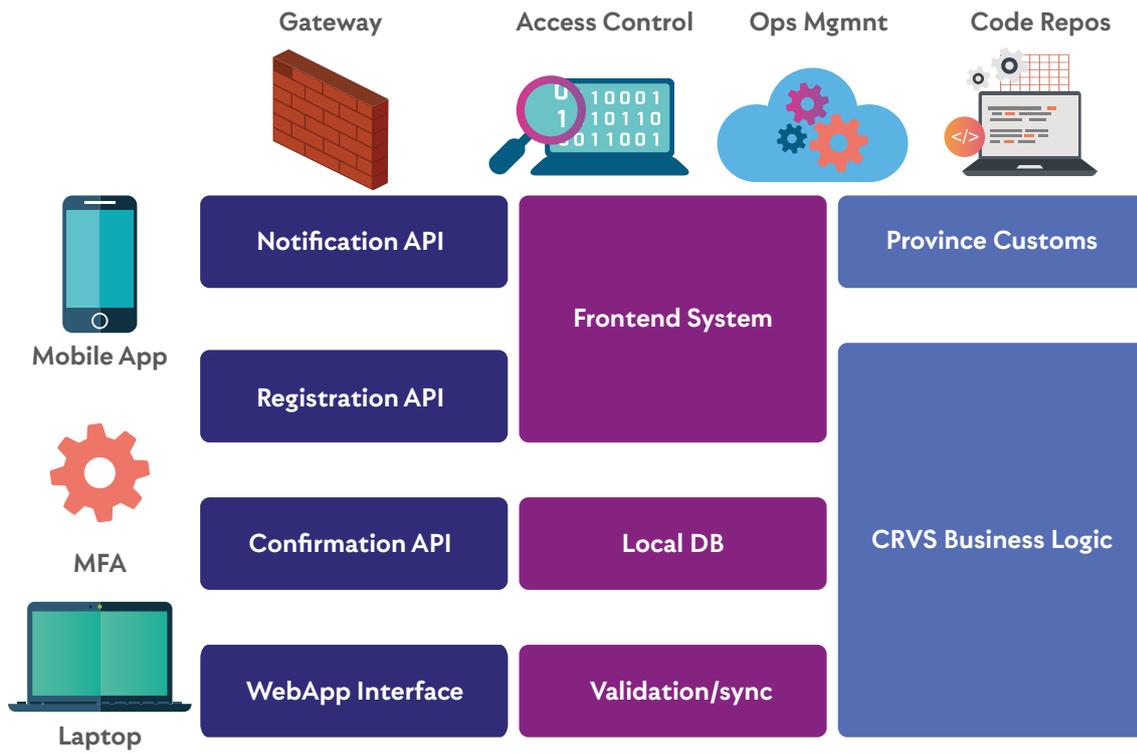


Figure 19 Extended Block Diagram of CRVS

With Figure 20 Extended Block Diagram of CRVS in mind and starting from top right going counter-clockwise, some of the most important functional extensions or additional components could be:

- A Code Repository (such as GIT or Bitbucket) in which the extensions to the Business Logic are being held, maintained, updated and managed
- An Operational Management tool(set) which enables the local (Provincial) IT experts to operate, monitor, maintain, update and generally manage all components including Backup / Restore, Data Integrity, De-Duplication, End-to-End Response Times etc.

- Access Control functionality and Management Interface for keeping track of roles, responsibilities, registered personnel, their access rights and entitlements as well as their current role scopes. Generally dubbed "Identity / Access Management" or "IAM"
- Gateway component which actually provides access to the APIs and WebUI of the WebApps, plus enforcing the Access Rights managed by 3)
- Mobile Apps or Mobile Devices accessing the APIs (Mobile Phones or Tablets)
- Laptop computers using browser to access the WebApp Interface
- Multi-Factor Authentication component that secures higher privileged access to the APIs and WebApp Interface, depending on the requirements defined through 3)
- Orchestration Components which directly or indirectly interacts with the UI of 2) actually providing the means and methods to run and operate the APIs and WebUIs and keep them available through migrations, updates, changes or any kind of hiccup the system may have.
- The centralized and fully synched Pakistani CRVS Database that holds the consolidated data of all provinces in one central store; to used, accessed and maintained cooperatively between the stakeholders on national and Province/District level
- Last but not least a Virtualization and/or Container Management component, similarly hooking into the interfaces of 2) and 8) to provide complete view of all containerized components.

Any further elaboration of these components requires the definition of the Business Processes, Support Processes and Management Processes that will form the Pakistani CRVS services backbone. As the author is unable to foresee the full scope and intended capability of such Pakistani services, the discussion will be continued based on generally agreed and documented parts of Generic CRVS Business Processes, as have been shown in several resources.

Section "CR" - Civil Registration

- CR1 - Declare Vital Event (including Notify and Record Vital Event)
- CR2 - Validate Vital Event Data
- CR3 - Register Vital Event
- CR4 - Provide Certificate for Vital Event
- CR5 - Generate Vital Event Data for Statistics Purposes
- CR6 - Archive Vital Event Data
- CR7 - Share Vital Event Data

Section "VS" - Vital Statistics

- VS1 - Compile Vital Event Data for Statistics Purposes
- VS2 - Quality Control Vital Event Data for Statistics Purposes
- VS3 - Generate Vital Event Data for Statistics Purposes
- VS4 - Disseminate Vital Event Data for Statistics Purposes

Taken from Assessment Report, the Figure 21 General Process Flow Chart, shows a sample flow of how Vital Events may be tackled, starting from the Parents across relevant Health Sector professionals, Nikkah Registrar personnel across Provincial Civil Registry Offices to the Central Vital Statistics Agency.

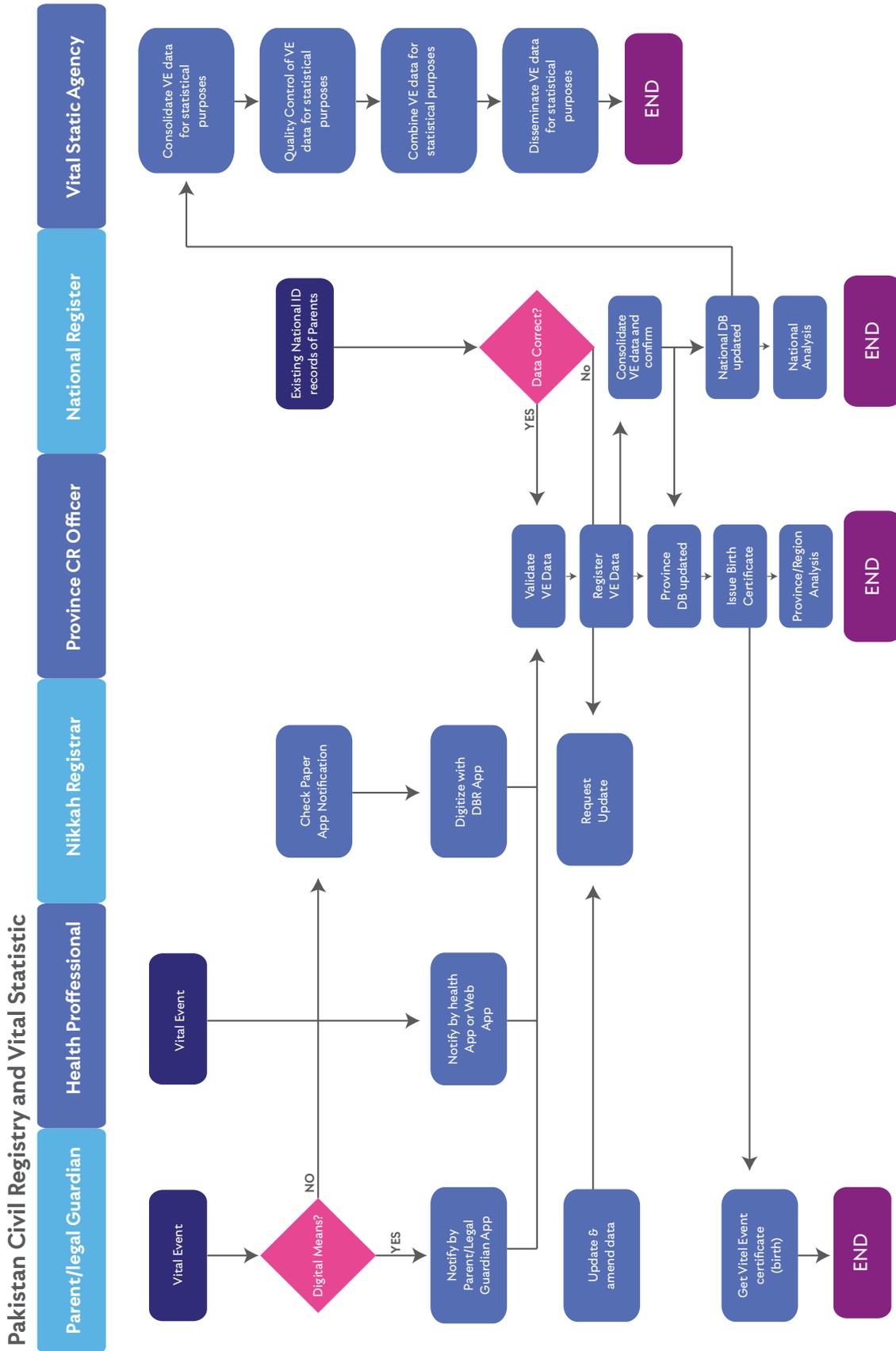


Figure 20 General Process Flow Chart

As the Notification Process initiated by parents or a legal guardian taking center stage as option to increase the registration rate for newborn children, the following figure elaborates how this process could look like, amended with the necessary information details to be gathered and transmitted by the app used for digital notification.

Assessment Report the further elaborates on the details of Birth Registration process as visualized withing Figure 22 Current Notification Process Flow Chart. The declaration of a Vital Event is dubbed as "Notification" and has been defined as any means with which a range of individuals are able to inform public services of such an event.

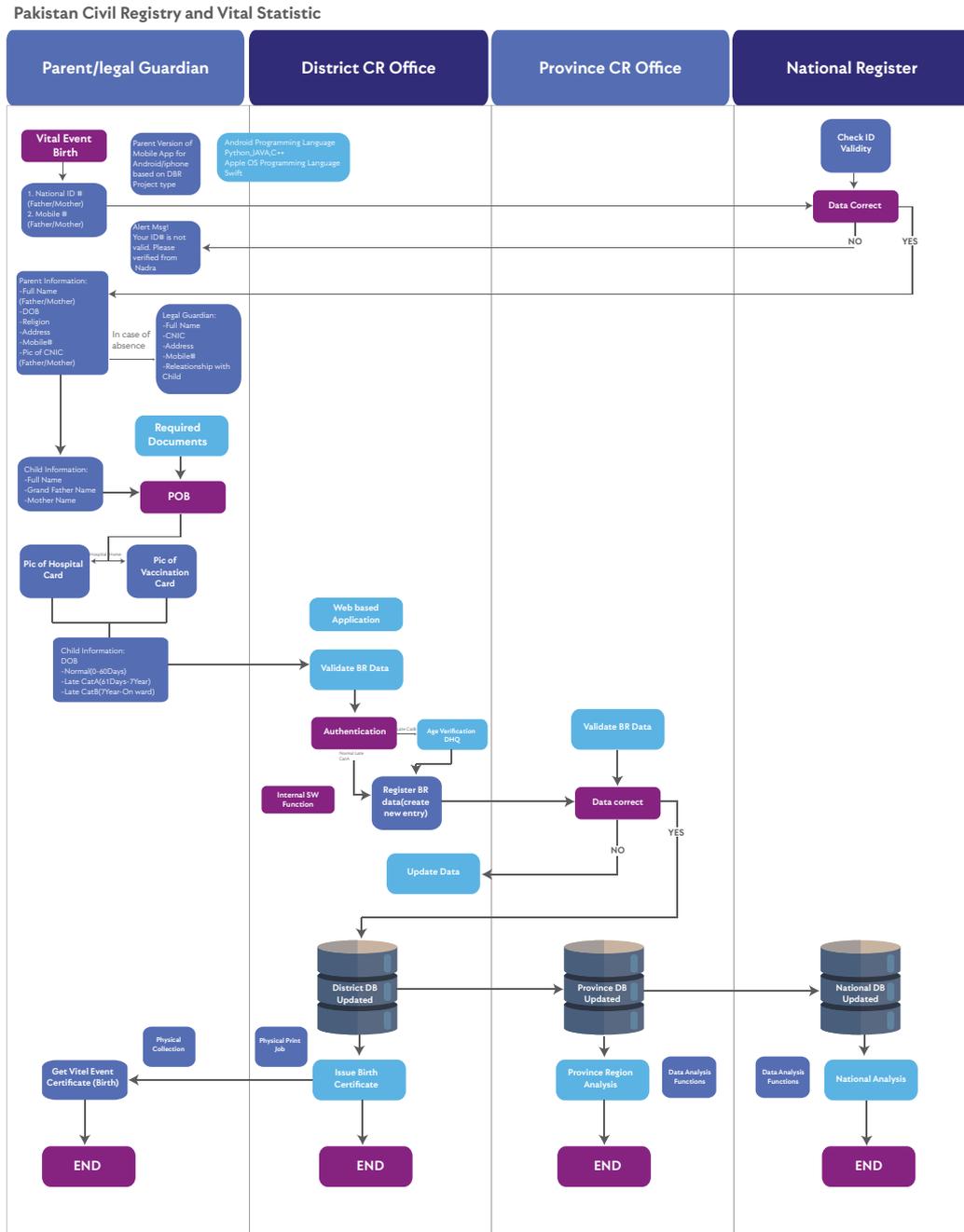


Figure 21 Current Notification Process Flow Chart

For further insights on how and where certain information sets are gathered under which specification, kindly refer to the full version of Assessment Report available to the interested reader.

4. Summary and Outlook

The scope of this analysis revolved around the technical aspects of the critical elements that are required for the formation of a comprehensive and optimally functional CRVS environment.

The analysis of the current CR structure showed massive shortcomings and lack of stringent implementation, especially with regard to steep difference between the already established and concrete Civil Identification (CI) system, run by the NADRA organization. While the protection of National ID data has high priority, NADRA databases do not provide sufficient means for providing Vital Statistics (VS) and analysis to any other third party, be it a Government Agency or related Ministry or any kind of private organization or NGO seeking for insights i.e. for Emergency Relief missions. Despite running a tight regime on data security in NADRA systems, lack of updates and fresh information from the field due to manual procedures of gathering such information from Provincial offices, NADRA has a certain mandate and scope which heavily revolves around National ID, Computerized National ID Cards (CNIC) and issuing these to Pakistani citizens. The task of registering Live Birth Events and issuing Birth Certificates remains with the local administrative bodies on lowest level, namely the Villages and Union Councils.

The only meaningful way forward seems to be, to establish a Vital Event Registration Network (VERN) which is completely set apart from any all bindings with the NADRA database.⁸ This VERN would span both classic Nikkah Registrar activities and community driven / operated sources, and extend itself across the Health Sector, Education, Legal Institutions and other possible sources, as can be seen in Infrastructure Manual. Many of these sources may leverage new digital technology such as introduced by the commendable efforts of the Digital Birth Registration (DBR) projects and its pilot installations.

It is strongly recommended to provide budget and governance means to a fundamental Requirements Analysis project, leading to a fully covered Requirements Specification for an ICT system on CRVS and its accompanying processes, procedures, legal frameworks and personnel capacity building in the administrative layers of Pakistani Government. While such an analysis may consume at least 9-12 month to reach a granularity that is sufficient, it is the only way forward that can guarantee a swift and timely decision on whether to “make or buy” a basic ICT system stack for CRVS. Even if the choice would be “buy” (i.e. invest into something like OpenCRVS or acquire a solution by a specialized vendor), massive customization and integration efforts would need to be taken to implement such a CRVS at full scale, indicating a project scope of at least four to six years just for planning, scoping, installation and configuration plus necessary adjustments.

Anecdotal evidence shows, that the full lifecycle for such an effort can reach nearly a decade (compare Jamaica National ID efforts) and may lead to investment needs of roughly 2 US\$ per citizen (leading to roughly \$500 Million budget for a 5-year planning horizon based on population growth scenarios).

With such long planning horizons and massive governance effort to cover all aspects and maintain coherence of sub-projects, technical planning details such as provided as part of the ToR become “indicatory” at the most.

From point of view of the author, any and all activities around CRVS in Pakistan should revolve around taking the very promising DBR project artifacts as a corner stone, but not by rushing the brittle and “proof-of-concept” grade architecture into production at scale. Such an approach would lead to an unstable, badly documented and fragile patchwork of functionality – it is instead highly recommended to use the above Requirements Specification and extend this with excellent UIs created by DBR, but re-factoring the whole

underlying Software Architecture to be built on a Container-based management platform and have it developed with Security Development Lifecycle (SDL), Secure Coding and proper Configuration Management. Pakistan has a lot of internal national ICT expertise and is well-known for their Software Development skills. With a proper set of requirements and strict Project Governance assisted by international ICT experts with a track record for building CRVS ICT infrastructures, Pakistan companies could very well implement many of the necessary and Pakistan-specific components of a CRVS on their own.

CIVIL REGISTRATION AND VITAL STATISTICS



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