



ADDIS ABABA UNIVERSITY

COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES

SCHOOL OF INFORMATION SCIENCE

Architectural Framework for Interoperable Social Protection Information System (SPIS) in Ethiopia: The Case of Productive Safety Net Program (PSNP) and Humanitarian Food Assistance (HFA) Programs

By:

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July/ 2023

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and Humanitarian Food Assistance (HFA) Programs**

A thesis submitted to the school of graduate studies of Addis Ababa University in
partial fulfillment of the requirements for the degree of Master of Science in
information science

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Declaration

I declare that the thesis is my original work and has not been presented for a degree in any other university.

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This thesis has been submitted for examination with my approval as a university advisor.

Temtim Assefa (PhD)

July 2023

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Table of Contents

Acknowledgement	i
List of Acronyms	vi
Abstract	1
 CHAPTER ONE:	2
BACKGROUND	2
1.1. Introduction	2
1.2. Statement of the Problem	3
1.3. Research Questions	5
1.4. Research Objectives	5
1.4.1. General Objective.....	5
1.4.2. Specific Objectives.....	6
1.5. Scope of the Study	6
1.6. Significance of the Study	7
1.7. Organization of the Thesis	7
 CHAPTER TWO:	8
REVIEW OF RELATED LITERATURE	8
2.1. Foundational Concepts and Definitions	8
2.1.1. Management Information System for Social Protection	8
2.1.2. Interoperable SPIS and Integrated SPIS.....	9
2.1.3. Interoperability between SPIS and DRIS (Disaster Risk Information System).....	11
2.2. Architecture for Information Systems: Theoretical Overview	12
2.2.1. Design Approaches for Information Architecture.....	12
2.2.2. Compare and Contrast the Design Approaches.....	18
2.3. Empirical Literature on MIS for Social Protection	21
2.3.1. Social protection Information Systems in Developing Countries.....	21
2.3.2. Social Protection MIS in Ethiopia: Policy and Practice.....	23
2.3.3. Ethiopian Electronic Government Interoperability Framework.....	24
2.3.4. Existing MISs for PSNP and HFA Programs and Potential Linkage	25
2.4. Related Research Works on SPIS	26
2.4.1. Research Gap in Interoperable SPIS in Ethiopia	27
2.4.2. Challenges in SPIS in Ethiopia	28
2.5. Chapter Summary	30

CHAPTER THREE:	31
RESEARCH DESIGN AND METHODOLOGY	31
3.1. Research Approaches	31
3.2. Research Methodologies	31
3.2.1. Design Science Research Methodology	32
3.3. Description of Study Organizations	33
3.3.1. Ministry of Agriculture (MOA)	33
3.3.2. Ethiopian Disaster Risk Management Commission (EDRMC)	34
3.3.3. Linkage between the two MISs	35
3.4. Data Collection Methods and Tools	36
3.4.1. In- depth Interview	36
3.4.2. Observation	36
3.4.3. Document Review	37
3.5. Target Population and Selection of Respondents	37
3.5.1. Target population	37
3.5.2. Selection of Respondents	38
3.6. Data Analysis and Presentation	39
CHAPTER FOUR:	40
ANALYSIS, FINDINGS AND DISCUSSION	40
4.1. Background of Respondents	40
4.2. Qualitative Data Analysis and Findings	41
4.3. Discussion	64
4.4. Chapter Summary	71
CHAPTER FIVE:	72
THE PROPOSED ARCHITECTURAL FRAMEWORK	72
5.1. The Proposed Architectural Framework for Interoperable SPIS	72
5.2. Description of the proposed Architectural Framework	74
5.2.1. Collaborative Business Axis	74
5.2.2. The Enterprise Dimension Axis	77
5.2.3. Level of Abstraction (Model Driven Development) Axis	81
5.3. Technological Requirements for the Proposed Framework	84
5.4. Validating the Architectural Framework	85
5.5. The value addition and contribution of the Proposed Framework	86
5.6. Strength and Limitation of the suggested Framework	87

5.6.1. Strength of the Proposed Architectural Framework	87
5.6.2. Limitation of the Proposed Architectural Framework	87
CHAPTER SIX:	89
CONCLUSIONS AND RECOMMENDATION	89
6.1. Conclusions	89
6.2. Recommendations	90
6.3. Future Works	91
Annex- Data Collection Tool.....	i
Bibliography	vii

Table of Figures

Figure 1: Architecture of Interoperable Information Systems (AIOS)	14
Figure 2: Architecture of Integrated Information Systems (ARIS)	15
Figure 3: Zachman's Framework for Enterprise Architecture	16
Figure 4: The Open Group Architectural Framework (TOGAF)	17
Figure 5: Structure of the TOGAF Architecture Development Method (ADM).....	18
Figure 6: Structure of the U.S. "Federal Enterprise Architecture Framework" (FEAF) Components	18
Figure 7: Operational Woredas of PSNP and HFA Programs	43
Figure 8: Relationship between PSNP and HFA Programs in PSNP target woredas.....	43
Figure 9: The envisioned Integrated Social Protection Information System in Ethiopia	45
Figure 10: PSNP-MIS User Interface	47
Figure 11: : PSNP-MIS User Interface on Reporting	48
Figure 12: User Interface of CATS and the different modules.....	49
Figure 13: Sequence diagram of key functions of PSNP.....	67
Figure 14: Sequence Diagram of the key functions in HFA.....	68
Figure 15: Activity diagram of key processes of PSNP	69
Figure 16: Activity diagram of key processes of HFA program	70
Figure 17: Private view of the proposed interoperable SPIS	75
Figure 18: Conceptual model of the proposed architectural framework	82
Figure 19: Logical data model of the proposed architecture	83

List of Acronyms

AIOS	Architecture for Interoperable Information System
ARIS	Architecture of Integrated Information Systems
CATS	Commodity Allocation and Tracking System
CIM	Computation Independent Model
DBMA	Data Base Management System
DRAP	Disaster Risk Assistance Plan
DRIS	Disaster Risk Information System
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EDRMC	Ethiopian Disaster Risk Management Commission
EeGIF	Ethiopian eGovernment Interoperability Framework
EIF	European Interoperability Framework
EWS	Early Warning System
FDC	Food Distribution Center
FSCD	Food Security Coordination Department
GOE	Government of Ethiopia
HDX	Humanitarian Data Exchange
HFA	Humanitarian Food Assistance
HRP	Humanitarian Response Plan
ICT	Information Communication Technology
IT	Information Technology
JRM	Joint Review Mission
MIS	Management Information System

MOA	Ministry of Agriculture
MOWSA	Ministry of Women and Social Affairs
NGO	Non Governmental Organizations
OCHA	United Nations Office for the Coordination of Humanitarian Affairs
OPM	Oxford Policy Management
PASS	Payroll and Attendance Sheet System
PDS	Permanent Direct Support
PIM	Platform Independent Model
PSM	Platform Specific Model
PSNP	Productive Safety Net Program
PSSA	Public Social Security Agency
POESSA	Private Organizations Employees Social Security Agency
RPASS	Rural Payroll and Attendance Sheet System
SOA	Service oriented Architecture
SPIS	Social Protection Information System
SPMIS	Social Protection Management Information System
SRSN	Shock Responsive Safety Net
TDS	Temporary Direct Support
USAID	United States Agency for International Development
WB	World Bank

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Abstract

Social protection program, by its nature, encompasses a variety of social services offered by various actors, requiring either interoperability or integration among their MISs to ensure effective service delivery to people in need. However, the different social protection programs in Ethiopia run independently and efforts to harmonize their MISs have failed for long. With that backdrop, this thesis aimed to propose an architectural framework for interoperable Social Protection Information System (SPIS) for two of Ethiopia's largest social protection programs, namely Productive Safety Net Program (PSNP)- V and Humanitarian Food Assistance (HFA) program. The study employed Design Science Research Methodology and specifically used Architecture for Interoperable Information System (AIOS) which is suitable to interoperate MISs of independent public organizations which is the case in this study.

Data was collected through in-depth interviews, observation and secondary sources. The data was analyzed and used as a spring board to propose a workable architectural framework. According to the study findings, there are a number of commonness and uniqueness between both programs in terms of their business functions, processes, data needs, organizations involved, operational location and beneficiaries. This information helped to identify which of these aspects would be managed privately by each, jointly by both or with other larger national systems. Along with this, the study also broadly identified the areas of interoperability between MISs of the two programs at business, technical and execution levels. Based on these findings, the study proposed an architectural framework for interoperable SPIS for the two programs.

The proposed architectural framework was presented to users and administrators of the respective information systems and it was positively validated by them with some preconditions by some of them. Based on the study findings and outcome of the validation, it is concluded that an AIOS based architectural framework for an interoperable SPIS for PSNP and HFA programs could be an ideal solution for MOA and EDRMC to ensure collaboration and data sharing between them without affecting their autonomy and independence or alter structure of their internal information management systems as well.

However, the study acknowledges that numerous technical, technological, financial and institutional challenges need to be addressed to effectively realize such interoperable SPIS in the country. Hence, a detailed business and technical scrutiny of the two programs and their MISs would further support implementability of the proposed framework.. There should also be good IT governance and political commitment to materialize an interoperable SPIS in the country. The recently launched national digital Id system in the country could be a good opportunity. Despite the challenges and opportunities, it is apparent that the proposed interoperability, if realized, would pave the way to actualize the long awaited integrated SPIS which more and more developing countries are enjoying these days.

Key Words: *Architectural framework, beneficiary register, civic register, Information System (IS), Integration, social protection, Interoperable Social Protection Information System (SPIS),*

CHAPTER ONE:

BACKGROUND

1.1. Introduction

We live in an era where information is the main capital and with knowledge as the currency of organizations [1]. The rapid evolution of information technology (IT) was the key driving force behind such information revolution that is witnessed in every sector [2]. No organization – be it private or public, business or charity, economic or social, military or civil- can survive and thrive without the use of IT for information management. The use of Management Information System (MIS) is thus at heart of any business operation today [3]

A well-designed MIS starts with and rests on the use of sound information architecture from the outset [4]. Given this, a variety of information architectures have been developed by various scholars of the field over the years. Previous information architectures were mainly focused on internal systems and the technical aspects of an enterprise, were thus largely suited for only intra-organizational MISs [5].

Given the increasing interconnectedness of organizations, trends have then shifted to integrated MISs and so did architectural frameworks. However, this was not again suited for public organizations for the fact that their traditional independence inhibits a tight integration between their information systems. This has given rise to interoperability research which promotes loose coupling of organizational systems that requires only minor changes of internal systems. The well-known Architecture of Interoperable Information Systems (AIOS) is one of those existing frameworks that helps to realize interoperable MISs possible [6].

Architecture of Interoperable Information Systems (AIOS) is a framework developed by Zeimann on the basis of European Interoperability Framework (EIF). The architecture represents a means for the comprehensive description of loosely coupled, interoperating information systems and for the systematic, model-based enactment of collaborative business processes. It combines concepts from the areas of enterprise modeling, collaborative business and Service-Oriented Computing [6]. Hence, AIOS has increasingly been used by sectors like social protection where there are many interconnected actors [7].

Social protection encompasses all public services that focus on reducing poverty, social and economic risk of citizens, vulnerability and exclusion to ascertain accessible and equitable growth to all [8]. Due to its humanitarian nature, the sector draws a wide range of stakeholders for service delivery, requiring more collaboration and data sharing among them. MIS for social

protection, also called Social Protection Information System (SPIS), is thus required to be an interoperable that has also linkage with MISs of other sectors including national ID system [7].

Coming to the case in Ethiopia, the government has two huge nation-wide social protection programs that reach out to tens of millions of people combined every year. The two programs have much in common, in terms of their main purpose, type of support and geographic presence. However, there continue to be duplication of efforts and beneficiaries where there is overlapping geographic presence. According to several researches, their poor data management system is the main reason behind and this has resulted in ineffective service delivery and at times entailed government accountability to the programs' donors [9] [10] [11] [12]. Though there is a strategic direction by the federal government to harmonize their service delivery, this is challenged due to lack of interoperability between their data management system among others [13].

Given the independence of the two organizations and the current challenges in collaboration, enabling interoperability between the MISs of the two programs would be of paramount importance in harmonizing their service delivery to the people in need. In this regard, the researcher believes the AIOS would be best fit to develop a sound architectural framework for such interoperable MIS. The interoperability between the MISs of the two social protection programs would in turn be a good starting point to move closer to an integrated SPIS in the country which is envisioned in the national social protection policy.

1.2. Statement of the Problem

The ability of a country to care for its people and respond to their lifecycle needs depends on the ability to identify those in need, enroll, provide tailored supports, follow up the services, and graduation and exit which all require dynamic and real-time data and information exchange [7]. Thus, social protection programs are essentially about managing of people's data throughout these schemes [14]. Besides, the multi-sectoral nature of social protection programs and the involvement of many actors necessitate establishing inter-institutional coordination measures. This in turn comprises interoperability mechanisms, which enable interconnecting the information systems managed by the different organizations involved in such programs

Cognizant of this, the Paris declaration and Accra Agenda for Action urges developing countries and development partners to harmonize their interventions to ensure effectiveness of aid. This requires, among other things, integrating their existing information systems of the different interventions to ensure quality evidence base for informed policy decisions [15]. In

line with this, GOE developed a national social protection policy, which envisions to establish a "central registry system" for its social protection programs aiming to organize and manage complete data and exchange information about their beneficiaries [8]. In line with this, the government has tried to materialize it as of 2016. However, due to many institutional and other factors, this couldn't be achieved. Due to this, recent efforts have shifted to at least first interoperate the two biggest social protection programs so as to address the serious data sharing problems between these two programs [10] [13]. As declared by the world Bank, Ethiopia, along with other 18 Sub-Saharan African countries is still struggling to set up SPIS [16].

Most notably, the national social protection strategy underlines the need for information exchange between safety net and humanitarian programs, and harmonizing their targeting system as well [11]. This mainly refers to two of the country's largest social protection programs: Productive Safety Net Program (PSNP) and Humanitarian Food Assistance (HFA) programs. These programs, despite their geographic and thematic similarity, are run by two different government institutions and use disjointed MIS. In relation to this, there has been reported overlapping of clients and duplication of efforts by actors as well [17] [18]. Had there been data exchange and interoperability between the MISs of the two programs, such redundancy of beneficiaries and resource wastage couldn't have been there.

In fact, the MIS in use for both programs have their own technical and operational challenges to serve their intended purpose [13] [10] [18]. However, the lack of harmonization between the two existing MISs has continued to affect their program performance and harmonized service delivery in the country. The study conducted on system and structure of PSNP and HFA reported that the existing MISs have made it difficult to harmonize household targeting and reporting for the two complimentary programs [13]. All periodical evaluations and reviews conducted on the programs have also consistently found out data and information management gap as the critical challenge, partly responsible for poor program performance. They have thus continued to call for- establishment of a central MIS for the two programs [19] [13] [20].

Due to the loose coupling principle that it follows, interoperable MIS is more feasible than an integrated MIS for autonomous organizations [5]. It is thus imperative for public organization in Ethiopia to adopt an interoperable MIS. To this effect, the GOE has developed eGovernment Interoperability Framework in 2019 [21], evidence on the extent of its application across sectors has not been clear. From the scholarly point of view too, such interoperable MIS is relatively a recent phenomenon in the social protection sector [2], garnering little attention from

academicians mainly in developing countries [22] [23]. In particular, studies on interoperability are almost non-existent in Ethiopia.

In sum, the use of MIS for the country's two largest social protection programs are recently introduced, operate in silos and above all little is known about how interoperable architectural framework could work for information system in public organizations in general and for those implementing social protection programs in particular.

Therefore, this study aimed to propose an adapted architectural framework for interoperable MIS for the two nation-wide social protection programs in Ethiopia, Productive Safety Net Program (PSNP) V and Humanitarian Food Assistance (HFA) programs which would in turn paves the way to realize an integrated Social Protection Information System (SPIS) in the country.

1.3. Research Questions

The research mainly intended to answer the question “How can the existing MISs of PSNP and HFA programs best be interoperable?”. In line with this, the study tried to answer the following specific questions:

- 1) How is the current processes and practice of information management systems of the two social protection programs?
- 2) What kind of architectural framework can be adapted for effective interoperability of the information systems of the two programs?
- 3) What challenges are out there to instrumentalize interoperable social protection Information system in the country?

1.4. Research Objectives

1.4.1. General Objective

The general objective of the study was to propose an adapted architectural framework that can be considered for interoperable MISs for Productive Safety Net Program (PSNP) and Humanitarian Food Assistance (HFA) programs, social protection programs implemented by Ministry of Agriculture (MOA) and Ethiopian Disaster Risk Management Commission (EDRMC) respectively.

1.4.2. Specific Objectives

In line with the general objective, the study aimed to achieve the below specific objectives:

- ✓ To identify the different information types and their relationship that PSNP and HFA programs are concerned with;
- ✓ To identify the process, functions, data and organizational dimensions that are required for interoperable information system;
- ✓ To identify the technical aspects to be considered for interoperable information system at business, technical and execution levels;
- ✓ To propose an adapted architectural framework that would help instrumentalize interoperable social protection management information system in Ethiopia

1.5. Scope of the Study

PSNP and HFA are two of the government's largest social protection programs in Ethiopia reaching out to tens of millions of people across all regions in Ethiopia. PSNP serves food insecure households through permanent support, while HFA provides temporary live saving support to disaster affected populations. Despite their divergence in focus, the two programs are complimentary both in terms of their geographies and beneficiaries. Hence, the research centered on the MISs of these PSNP and HFA programs. In particular, the research saw how the MISs of the two programs could be interoperable and serve some common functions like targeting of beneficiaries.

In line with this, the study included Ministry of Agriculture (MOA), the public body responsible to lead the PSNP; and the Ethiopian Disaster Risk Management Commission (EDRMC), the one responsible to coordinate HFA. In addition, selected governmental and non-governmental organizations which were taking active role in implementing these two social protection programs in the country were involved.

The MIS being the central focus, the study explored how the key functions expected of an interoperable MIS was being handled by the existing MIS of the two programs. Specifically, the study focused on how the MISs were serving the registration, targeting, service delivery, payment, grievance handling and exit/ graduation. As part of this, the study saw how data about these functions was being collected, stored, processed, reported, utilized and disseminated.

However, given the fact that both PSNP-MIS and CATS are continuously evolving into a full-fledged system, the focus of this thesis was to propose a high level architectural framework to

interoperate the two information system. The aim was to evidence how the two information systems could possibly interoperate for the best interest of their respective programs and the government at large.

The PSNP and HFA programs have been using different MISs in their life time. But, the focus of this study was the existing MIS currently being used by the programs. Hence, the temporal scope was that of 2023 fiscal year. As the programs are centrally managed, the geographic focus was at federal level, i.e. those institutions operating at this level.

1.6. Significance of the Study

The GOE is currently working to harmonize implementation of PSNP and HFA programs in the country. Hence, the proposed architectural framework for interoperable MIS would enhance this effort by supporting MOA and EDRMC, the two public bodies managing PSNP and HFA programs in place interoperable MIS for their programs. This would also be a basis to progress towards integrated SPIS that could serve other social protection programs as well. In that sense, this research would have paramount practical significance for the GOE to instrumentalize its long awaited nation-wide MIS envisioned in its policy. It is hoped that the recently launched national digital identity system in the country would provide a unique opportunity to move towards one centrally managed MIS for social protection programs.

Besides, SPIS is not only a relatively recently introduced MIS in the social protection sector, but is also less researched topic in the academic arena. In particular, scholarly literature related to SPIS in Ethiopia and interoperable IS research is nearly non-existent. Hence, the research is expected to throw some lights into the body of scholarly literature on the subject as well.

1.7. Organization of the Thesis

The thesis has six Chapters. The first chapter introduces the study with focus on the background of the study, statement of the problem, research questions, objectives of the study, scope of the study, and significance of the study. The literature review part of the thesis puts discussion on the conceptual, theoretical and empirical literature relevant to MIS in general and interoperable MIS for social protection programs. Chapter three is entirely dedicated to the discussion of research methodology, i.e. research design, research approaches, research methodology, data collection and analysis methods. In chapter four is made presentation, analysis, and discussion of the data. Then follows the proposed architecture for the interoperable SPIS in chapter five. The last chapter sets forth conclusions and recommendations.

CHAPTER TWO:

REVIEW OF RELATED LITERATURE

This section reviews existing literatures related to interoperable social protection information system. It first shades light on conceptual background of MIS in general and interoperable SPIS in particular. Then, it discusses the different information architecture frameworks for interoperable and integrated systems including comparing and contrasting them in line with the purpose of the study. The third section brings empirical evidence from selected developing countries which in place SPIS and the case in Ethiopia focusing on PSNP and HFA programs. The final section presents related studies conducted on interoperable MIS in general and SPIS in particular

2.1. Foundational Concepts and Definitions

2.1.1. Management Information System for Social Protection

Social protection encompasses all those programs aiming at reducing poverty, social and economic risk of citizens, vulnerability and exclusion by taking measures through formal and informal mechanisms to ascertain accessible and equitable growth [8]. So, it is the MIS used in the social protection sector that has nowadays become Social Protection Information System (SPIS) [7].

SPIS is referred differently in different countries. It is called- Unified Database (For example in Indonesia), Single Registry Database (For example in Uganda and Kenya), Social Registry Database (For example in Brazil, Unified Household Information Registry Database (For example in Chili), Poverty Database (For example in Turkey) [2]. However, the scope and purpose of these SPISs could be different as their names vary.

MIS is core to the design of social protection schemes: targeting, registration, condition, payment, grievance, exit and graduation. As each scheme is regarded as system of information management, SPMIS can itself be considered as managing information about people passing through each scheme [14]

While the general benefit of MIS for any organization works for social protection too, MIS could provide special benefits for social protection sector. These benefits are mainly linked with inclusion, equity, coordination and knowledge purposes as summarized below. [7]

- **SPIS increases responsiveness to, dynamic inclusion and equity of** all the needy in social protection interventions through tailored benefits and services.

- **SPIS increases equitable distribution of resources through** enabling oversight of multiple schemes and establish links with other services,
- **SPIS improves coordination and linkages** with other social assistance programs and wider social and economic services,
- **SPIS improves Knowledge and understanding of poverty and vulnerability by** keeping socio economic data about citizens and tracking their changes over time,

SPIS can be of different types. based on the financial, institutional, technological, and political capacities of the nation. [24]. Based on the population whose data is kept and functions of the system, SPIS can be grouped in to social registries and beneficiary registries. Social registries are information systems that support outreach, intake, registration, and determination of potential eligibility for one or more social programs. On the other hand, beneficiary registries, also called ‘program MIS’, contains same information about a given population, but are only concerned with beneficiaries of a given social program. So, the key difference is beneficiary registries would only help track service delivery to existing beneficiaries, while social register can provide a “gateway” for targeting of new populations as well [25] [26] [22]

The other category of SPIS can be made based on the way the system works with other systems. Based on this, we can have an interoperable SPIS and integrated SPIS. These are discussed in the next section.

2.1.2. Interoperable SPIS and Integrated SPIS

Interoperability and integration of information system are closely related term which sometimes are used interchangeably. But, the two terms are quite different in their meaning. Interoperability refers to the quality of two or more MISs operate together or share some data. Whereas integration implies the quality of two or more MISs function as one system. Interoperable SPIS and integrated SPIS thus differs in their scope, in the way they function and degree of collaboration between partnering organizations [27] [25].

Interoperable SPIS refers to the connectedness and joint operation of two or more MISs serving different organization working on social protection. Interoperable SPIS has the main purpose of ensuring information exchange between different MISs and business collaboration of organizations at large. In interoperable SPIS, collaborating organizations keep their autonomy in operation as it uses loose coupling to link the MISs [27] [6].

Integrated SPIS; on the other hand, refers to the broader registry that involves flow and management of information within the social assistance sector and other government registries and information systems [16]. Hence, Integrated SPISs facilitate multiple information management functions for a single or range of programs and services as a unified MIS, meaning the different organizations rely on one common system to manage their data. These integrated systems often include social registries, beneficiary registries, payment systems, case management and grievance redress systems, and protocols and frameworks for interoperability and data exchange. [22]

Both interoperable and integrated SPIS requires linkage with other systems, though the degree varies. For interoperable SPIS to function effectively, the two linked systems are required to use at least common identifiers like national ID number. But in case of integrated SPIS, the MISs are unified in to one single system serving the interest of all organizations. In that sense, an integrated SPIS is also the highest form of interoperable SPIS.

According to Barca and Chirchir, alignment with the below national system would increase the interoperability and integration of SPISs [7]

- **National ID system:** This system can support the identification and authentication of individuals, with potential benefits in terms of interoperability between registries
- **Civil registry:** A civil registry can pre-populate, verify/validate/authenticate and update information on life events (e.g. births, deaths, marriages, etc.).
- **Disability registry:** Data from the disability registry can be usefully linked to social protection programming, and vice versa, to mainstream support to PWDs.
- **Income/tax & land cadastre registries:** Data from tax registries, land cadastres, car registration agencies etc. can aid the assessment and verification of self-reported information for assessing needs and conditions of potential beneficiaries
- **Education, health, social services systems:** Data exchange with other social sector information systems can enhance overall coordination and planning, as well as monitoring the compliance of co-responsibilities,
- **GIS system:** This can support monitoring, coordination, planning and operations that are tailored to the needs of specific areas
- **Humanitarian and DRM data/systems:** Data from the humanitarian and DRM sectors can be used to feed data into existing social protection registries – and vice versa. As this is relevant to this proposed research, it is further discussed in the next sub-section.

Table 1: Compare and Contrast between Interoperable and Integrated SPIS

Interoperable SPIS	Integrated SPIS
Adopts loose coupling	Adopts tight coupling
Different MISs linked to function together only for selected type of information	Different MISs brought into one single/unified MIS
May not need a central national MIS	Requires one central national system
No need to have middleware (systems communicate each other)	Need to have middle ware that let MISs communicate each other
Collaborating organizations keeps their autonomy at least partially	Collaborating organizations may loose their independence in terms of information management
Component MISs shouldn't necessarily integrate	Integrated SPIS also offers possibility for interoperability
Ideal for business collaboration	Ideal for business integration

Source: [28] [16] [29]

Based on the above comparison, interoperability is more relevant and practical for the case at hand. Given PSNP and HFA are run by independent public organization which has their own data management system, along with the lack of centrally managed civil registry system makes interoperability more realistic. Besides, there is already collaboration platforms for the two public organizations leading the programs would be a fertile ground to realize the planned interoperable SPIS. Most importantly, an interoperability can facilitate further integration of MISs, thus achieving interoperability could be the least that the level of the institutional capacity of the target organizations allow at this time.

2.1.3. Interoperability between SPIS and DRIS (Disaster Risk Information System)

Given social protection programs deal with people in need of support, those affected by disaster are also the subject of social assistance programs. In this sense, As such SPIS is closely linked with Disaster Risk Information System (DRIS) or DRIS can be considered as one type of SPIS. According to Asha and Moreira, DRIS is basically composed of three interrelated information systems: Geographic Information Systems (GIS), Early Warning Systems (EWS) and Registries of Disaster Affected Households (RDAHs) [28]

SPISs often contain a wealth of demographic, dwelling and socioeconomic information relevant for addressing disaster risks, and often, for a large number of people than other MISs. Hence, SPIS plays key role in informing resilience building measures and improve capacity to prepare for, cope with and adapt to covariate shocks and disasters [28]

For this reason, there is a general consensus today that SPIS and DRIS should be closely linked to serve both their respective objectives. Interoperability between SPISs, including social registries, with different DRISs and tools including hazard maps, EWSs, and registries of disaster affected households could facilitate better informed decision making, both ex-ante and ex-post, such as improved risk mapping and profiling. Otherwise, Asha and Moreira argue that SPISs and DRISs, if operate in isolation, offer limited utility for effectively addressing the disaster risks faced by individuals and households [28]

To sum it up, GIS helps SPIS to improve risk mapping, risk identification, vulnerability assessment and risk communication. Whereas, use of EWS helps SPIS trigger processes for horizontal and vertical expansion of post-disaster benefits to beneficiaries. RDAH, on its side, helps SPIS to verify data collected and track beneficiaries in post-disaster contexts [28].

2.2. Architecture for Information Systems: Theoretical Overview

2.2.1. Design Approaches for Information Architecture

Information architecture is a component of enterprise architecture that deals with the information component when describing the structure of an enterprise. A variety of information architecture designing approaches have been developed by various scholars. Selecting the right architecture is the first step to develop an effective information system. This depends on the nature of the sector/ organization, the purpose of the architecture, the level of relationship with other system, etc. However, many architectures can follow one or combination of them [4].

The following are the main enterprise architectures considered and weighed in for their suitability for this research.

a) Architecture of Interoperable Information Systems (AIOS)

Architecture of Interoperable Information Systems (AIOS) is one of the latest architectural frameworks borne out of the weakness of previously developed frameworks. It is developed by Jörg Ziemann in 2010 based on the European Interoperability Framework¹. the framework

¹ The European Interoperability Framework (EIF) is a guiding tool which specify how [administrations](#), [businesses](#) and [citizens](#) communicate with each other within the [European Union](#) and across [Member State](#) borders.

tries to provide comprehensive and business driven development of collaborative business processes. Hence, it identifies solutions in three major fields: At Service Oriented Architecture (SOA), collaborative businesses and business process modeling [5]

- **Enterprise architecture:** This refers to systems that comprehensively describe all relevant enterprise dimensions, incorporating distinct views on data, process, function and organization elements;
- **Collaborative businesses:** This is where the framework describes the collaboration between partner organizations
- **Service Oriented Modelling:** While the previous two fields incorporate business-level concepts, SOA rather focuses on the implementation of business processes.

In terms of collaborative views, AIOS identifies information system for private, public and global view. The private view comprises the only internally visible information system elements, while the public view acts as an interface to the internal and protects internal systems and enables interoperability without the need for a significant change to the internal systems. The global view is used to correlate and connect the public views of different systems [6]

AIOS also identifies information in four different dimensions. In the organizational dimension, roles, units and other organization elements relevant for the collaboration are described and related to internal elements. In the data dimension, document types used in the collaboration are defined and related to internally used document types. While in the function dimension, business functions and services offered in the collaboration are described; and finally in the process dimension, the processes that each organization offers are described as well as how these public processes are related to adjacent processes of partner organizations [6].

At the level of technical granularity, AIOS uses three level of analysis: at business, technical and execution level. At business level, the processes to be automated are described from a technique independent level. Whereas at technical level, the IT concept is described and the models from the first level are technically enriched. At the execution level, the machine interpretable models are used during runtime in the execution of processes [6]

AIOS has a number of advantage over other architectures in terms of developing interorganizational MIS. In the first place, AIOS provides comprehensible and comprehensive description of the interoperable information systems starting on the business requirements level and reaching down to the execution level. This has made collaboration and implementation of the system more practical and user friendly. Secondly, AIOS preserve internal systems of

organization or make as few changes as possible to their system; and this helps organizations to protect private information. In relation to this, the interoperating systems is tightly integrated, making it easier connection for the systems to establish and abort. In addition, the AIOS exploit and support the possibilities for enacting collaborative business processes offered by modern execution technologies like SOA. It also enacts decentral processes that would leave parties with equal rights to enact the collaborative business processes based on previously made agreements among the organizations [5] [6].

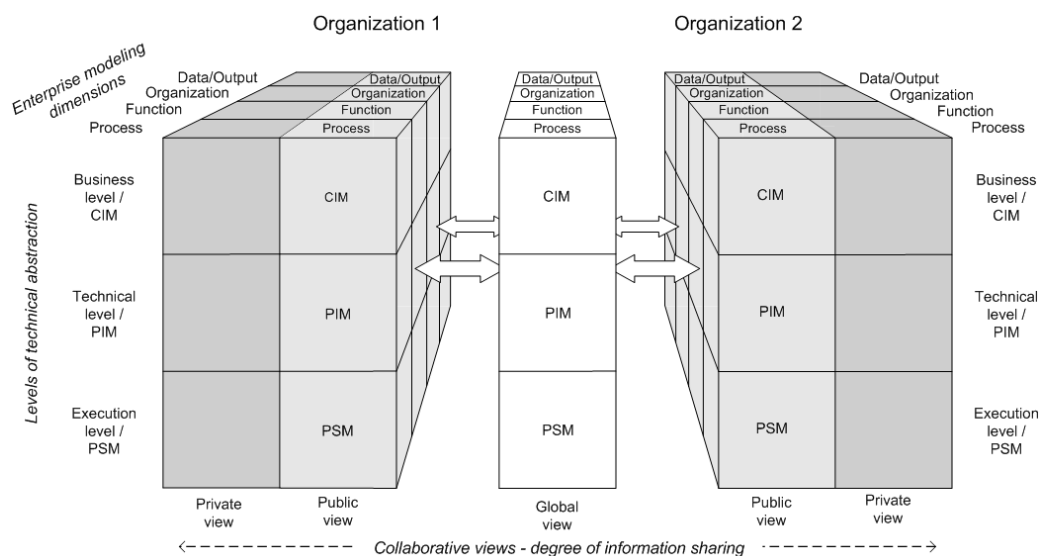


Figure 1: Architecture of Interoperable Information Systems (AIOS)

On the other hand, AIOS is criticized for a number of factors. Among others, AIOS doesn't consider the organizational culture of the collaborating organizations which affects the effectiveness of the architecture. Besides, member organizations are free to make change to leave out the interoperable MIS and to make any changes in their internal system, complicating the joint operation of the system .

b) Architecture of Integrated Information Systems (ARIS)

ARIS is an architecture for enterprise modeling developed by August-Wilhelm Scheer in the 1990s to ensure that an enterprise information system can completely meet its requirements. ARIS is used for developing, optimizing and implementing an integrated application system from a process point of view in information systems or in all types of business, manufacturing, services and public sector industries [30].

ARIS organizes data and information along with its own five-view architecture also called ARIS house, consisting of organization, data, service, functional and process views of a process [30].

- **Function view:** The activities and the groupings and hierarchical relationships that exist between them are described in the function view,
- **Organization view:** It provides an overview of the organizational structure of a company, including human resources, machines, hardware and their relationships,
- **Data view:** All events (that generate data) and environmental data, such as correspondence, documents, etc., i.e. all company-relevant information objects,
- **Product/Service view:** Provides an overview of the entire product/service portfolio including services, products, financial
- **Process view:** The process view connects all other views into a time-logical schedule,

In addition, the framework describes the view on each at three levels [30]:

- **Concept-** Structured representation of the business processes by means of description models that are understandable for the business side;
- **Data Concept:** Implementation of the technical concept in IT-related description models
- **Implementation:** IT-technical realization of the described process parts (depending on the view,

One of the strength of ARIS is works for any kind of organization including for public organizations. The classification that it uses also helps to simplify business process modeling simpler. However, ARIS is criticized for the fact that it mainly integrates information

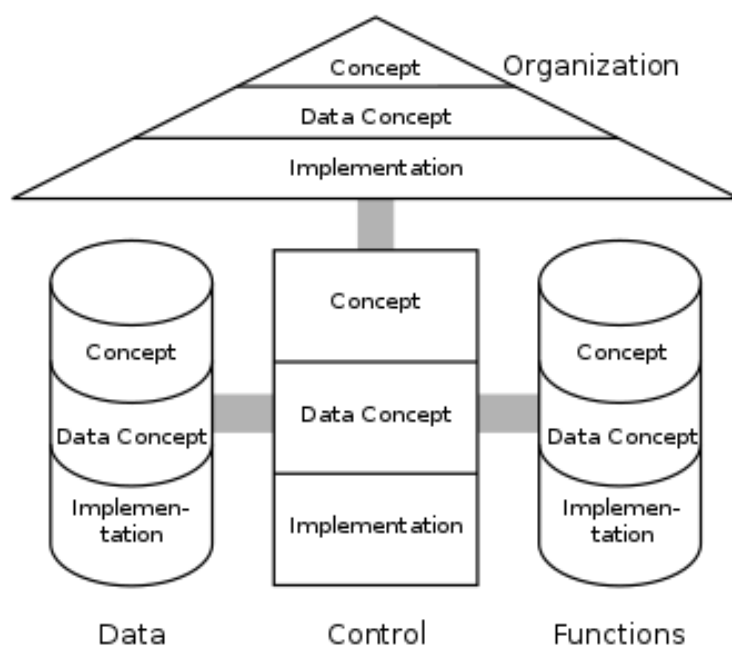


Figure 2: Architecture of Integrated Information Systems (ARIS)

c) The Enterprise Architecture Framework (EAFEAF)

EAF, also called the Zachman Framework for Enterprise Architecture, is simply a logical structure for classifying and organizing the descriptive representations of an organization and development of its information system. The Zachman Framework is not a distinct methodology for collecting, managing, or using the information that it describes; rather, it is an ontology whereby a schema for organizing architectural artifacts [31].

This framework uses a 6 x 6 matrix with six perspectives or views: executive perspective (scope contents); business management perspective (business concepts); architect perspective (system logic); engineer perspective (technology physics); technician perspective (tool components); and enterprise perspective or (operations instances). Column wise, it deals with six basic questions: What (Inventory Sets), How (Process Flows); Where (Distribution Networks), Who (Responsibility Assignments), When (Timing Cycles) and Why (Motivation Intentions) [32].

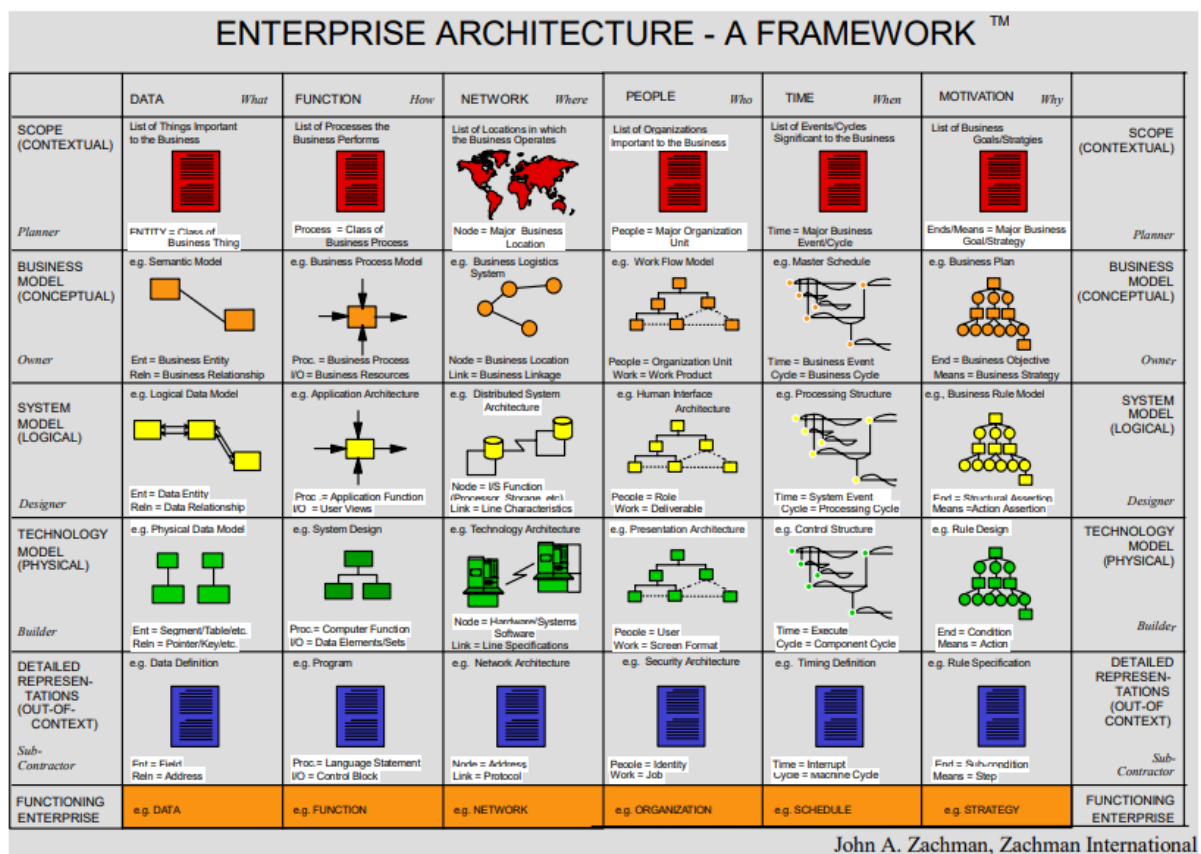


Figure 3: Zachman's Framework for Enterprise Architecture

One of the positive sides of Zachman framework is it focuses on ensuring that all views are well established, ensuring a complete system regardless of the order in which they were established. Besides, the framework has no explicit compliance rules since it is not a standard written by or for a professional organization. On the negative side, the framework does not provide guidance on sequence, process, or implementation, but rather [32]

d) The Open Group Architectural Framework (TOGAF)

The Open Group Architectural Framework (TOGAF) was first developed in 1995 based on the Department of Defense's Technical Architecture Framework for Information Management. A key element of TOGAF is Architecture Development Method (ADM) that specifies a process for developing enterprise architecture". TOGAF explains rules for developing good principles, rather than providing a set of architecture principles [33]

The framework is divided into four categories as follows

- **Business architecture** - describes the processes the business uses to meet its goals
- **Application architecture** - describes how specific applications are designed and how they interact with each other
- **Data Architecture** - describes how the enterprise data sources are organized and Accessed
- **Technical Architecture** - describes the hardware and software infrastructure that applications and their interactions

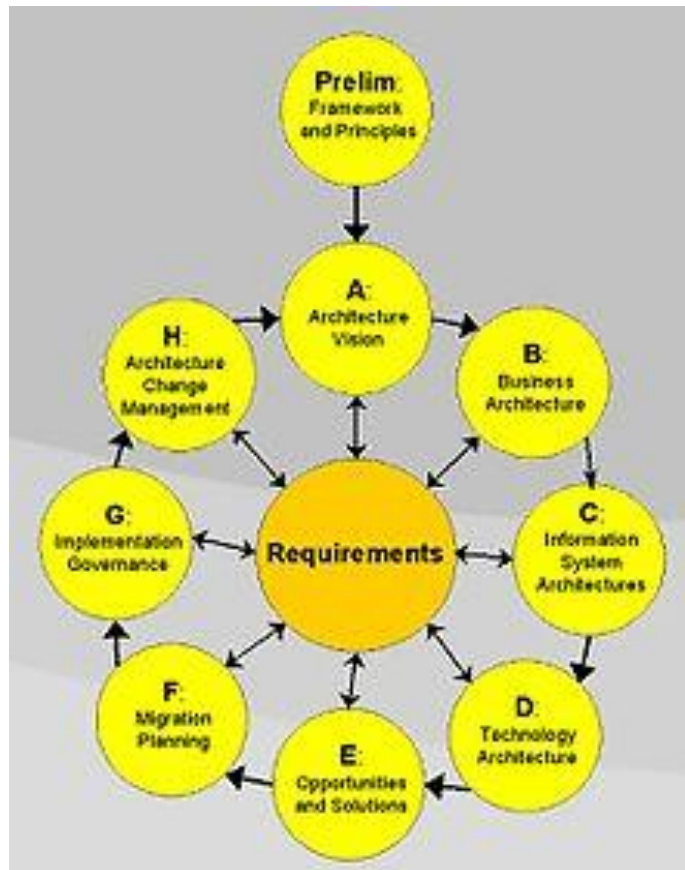


Figure 4: The Open Group Architectural Framework (TOGAF)

TOGAF is preferred for the fact that any organization can use it freely to design enterprise architecture as it is publicly available and free to use. This provides any organization to evaluate

and build the right architecture as well. As a result, TOGAF is among the most widely used frameworks.

e) The Federal Enterprise Architecture Framework (FEAF)

This took a perspective that an enterprise is built by segments and a segment is a major line-of-business functionality. These segments are developed individually and considered to be their own enterprise within federal enterprise. There are two types of segments; core-mission-area segments and business services segments [32]

FEAF is developed by employing the classification of five models which are for references namely (a) the

Figure 5: Structure of the TOGAF Architecture Development Method (ADM)

Performance Reference (b) a Business Reference, (c) A Service component reference, (d) Data Reference, and (e) Technical Reference Model. This framework facilitates U.S. Federal Agencies to share information and design common process between other agencies. The FEAF also focus on functional roles and EA core team member's responsibilities.

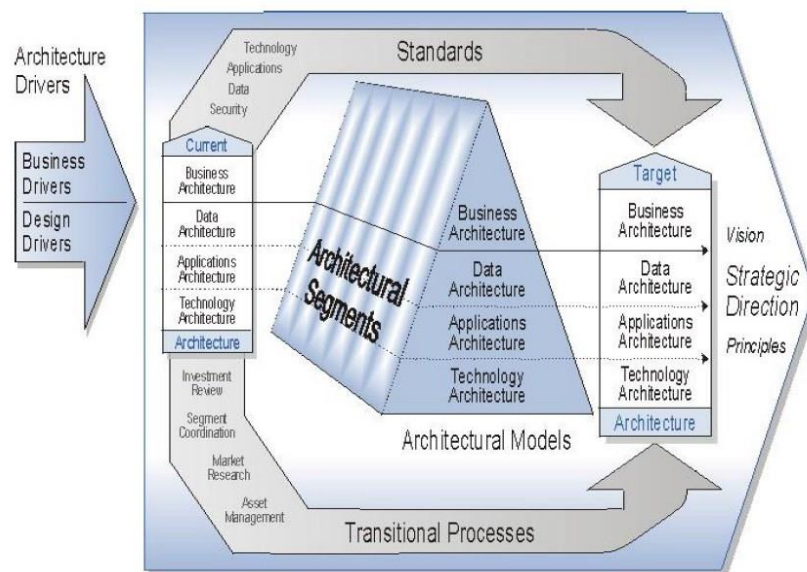


Figure 6: Structure of the U.S. "Federal Enterprise Architecture Framework" (FEAF) Components

2.2.2. Compare and Contrast the Design Approaches

As discussed in the previous section, each enterprise architectural framework is developed on different grounds and purposes. All the frameworks can be used in combination with one another but each has the following key differences and similarities.

Table 2: Compare and Contrast between the different Information Architecture

Parameter	Architecture of Interoperable Information Systems (AIOS)	Architecture of Integrated Information Systems (ARIS)	Zachman Framework for Enterprise Architecture (FEA)	The Open Group Architectural Framework (TOGAF)	The Federal Enterprise Architecture Framework (FEAF)
Purpose	Designed mainly for interoperability	Designed for integration	For both integration and interoperability	Focused on intra organizational MIS	Mainly for utility and interoperability of ISs
Type of MIS	For Interorganizational MIS	Mainly for intraorganizational MIS	For both intra and interorganizational MIS	Focused on intra organizational MIS	Works for both intra and multi-organizational MIS
Description	Combines Collaborative Business and Business Process Modelling	Is an information model within the entity-relationship approach	An ontology for enterprise architecture	A detailed method and a set of supporting tools	For integration of strategic, business and technology aspects
Orientation	Uses Service-Oriented Architecture	Uses Process-Oriented Architecture	Uses Product-Oriented Architecture	Uses Process-Oriented Architecture	Uses Process-Oriented Architecture
Flexibility	Provides flexible architectural framework	Leads towards standardization	Provides rigid and standardized framework	Provides adaptive and customizable framework	Provides rigid and standardized framework
Guidance	Provides generic guide in developing the architecture	Provides structural connections into any aspect of an enterprise	Provides a comprehensive guide in developing the arc.	Provides generic guide in developing the arc.	Provides a common meta-architecture framework
Nexus with other IA	Complimentary to ARIS	Can compliment with other architecture	Can compliment with other architecture	The pioneer and most used	Combines the best of both the Zachman Framework and TOGAF.
Focus on IT	Goes beyond IT	Goes beyond IT.	Focuses on IT and beyond	Focuses more on IT	Focuses on IT and beyond

As shown in the table above, each of the five frameworks have their advantages and disadvantages based on the purpose of the intended information system. However, Architecture for Interoperable Information System (AIOS) has advantage over the others for the interoperable SPIS envisioned in this thesis:

In the first place, AIOS is better suited for establishing inter-organizational information systems which is the case in this research. Of course, FEA and FEAF can also serve intra and interorganizational MISs, however AIOS differs with them in that it is service oriented, whereas FEA and FEAF follows product oriented and process oriented architecture respectively. Besides, AIOS gives greater emphasis to ensure collaborative businesses, while FEA and FEAF focus more on the technical side of the architecture. One more clear difference was that AIOS is set to serve interoperability, whereas the others can serve both integration and interoperability purposes.

Secondly, AIOS identifies private, public and global views which help to categorize organization-specific (hidden), shared and open to all information [5]. This means the two institutions managing the proposed interoperable framework system can preserve their internal systems without much modification to their existing ones. Of course, partitioning the system into private and public space is what many of interoperable frameworks share. However, AIOS is distinct in that it has the global dimension that would take the interoperable systems into an external system which provides opportunity to be linked with national level Id systems.

Thirdly, AIOS promotes loose coupling meaning the two systems need not be tightly linked, instead, the connection among the systems should be easy to establish and abort. And, given the independence and autonomy of the two institutions, AIOS is best placed to propose a workable interoperable framework.

Fourthly, AIOS adopts a comprehensive approach. This means. The proposed MIS cover the aspects needed for collaborative business processes, starting from the business requirements level and reaching down to the execution level, revealing the potential advantage of the framework to increase collaboration between the two institutions that is currently a critical challenge for the government.

It is on the above grounds that the research used Architecture of Interoperable Information Systems (AIOS) framework to develop the architecture.

2.3. Empirical Literature on MIS for Social Protection

2.3.1. Social protection Information Systems in Developing Countries

Evidences and practices on interoperable and integrated data and information management for social protection has grown considerably in the last 20 years. SPIS came into attention back to the late 70s and early 80s, when Chile and South Africa were starting to set up their SPIS. Following some further experiences from other countries, the SPIS process has notably accelerated different parts of the world; and developing countries were not exceptions, though lags behind the developed world [16].

According to data from the World Bank some sort of social protection information system was already fully institutionalised in 30 low- and middle-income countries worldwide of which six were in Africa. Currently an additional 31 countries, 18 of which are in Sub-Saharan Africa are considering and developing options for integration of MISs in this sector [16].

Given the increasing experience in establishing integrated SPIS across the world and in developing countries in particular, some good practices have been emerged that countries like Ethiopia could benchmark for their envisioned SPIS. The following are among the system with good experiences that other developing countries can learn from [29]

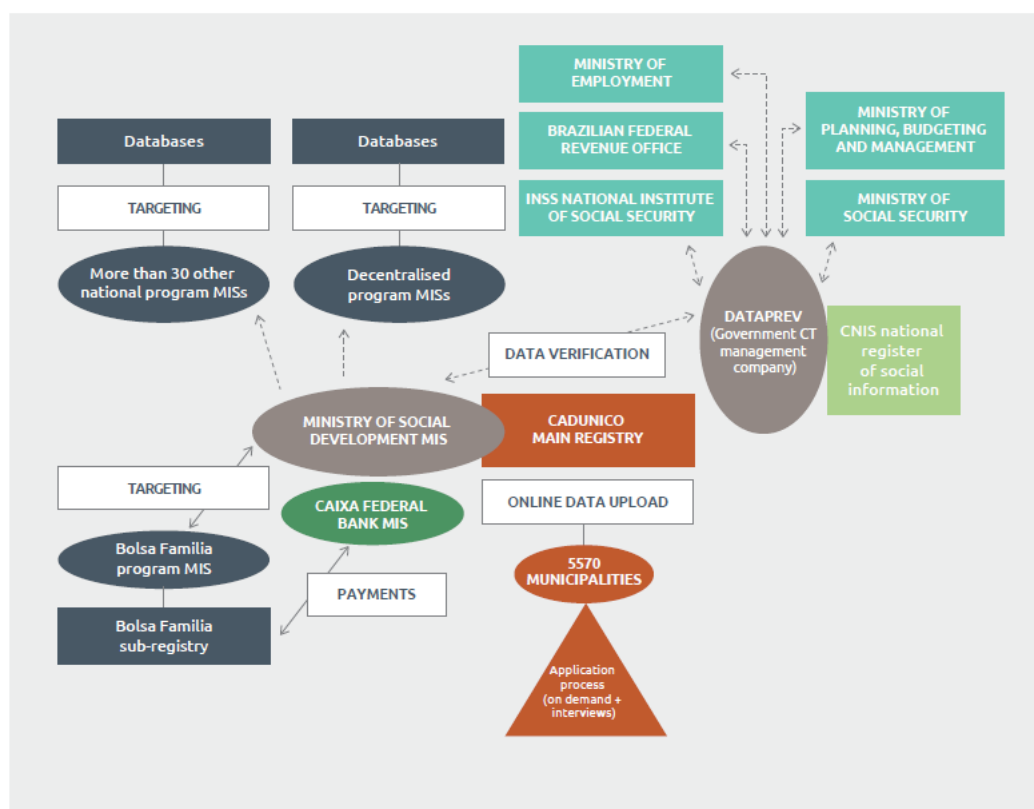
a) Cadastro Único (Brazil)

Cadastro Único is possibly the most famous of social registries internationally, setting standards for many other countries working on social registry. Único (translated as Unified Registry) is a social registry of Brazil started functioning as of 2001. It is a combination of on-demand registration (with home visits when needed) and occasional census surveys in selected areas. The system integrates data collection and eligibility determination across selected social assistance programs and provides some linkage to other social sectors. It also integrates with external databases primarily for data verification. The database currently contains information on 26.8 million households (2015), some 43 per cent of the country's population [29]

As shown in the below map, Cadastro Único is linked with the country's labour data, income data, social security, banks, etc systems and serves over 30 programs at national and sub-national levels. It operates at both national and decentralized levels including in 5570 municipalities. The system is used for targeting and payment services [29]. Cadastro Único is praised for informing decision makers on the magnitude of poverty and vulnerability.

However, it is criticized for it does not enable comprehensive overview of beneficiaries across programs) and does not have direct link to national ID system. The fact that it integrates with external databases primarily used for data verification is its another demerit [16]

Figure 11 Overall structure of Brazil's Cadastro Único



Source: Discussions with ministry staff (2016); and Oxford Policy Management Brazil poster (2015a).

Note: Boxes indicate databases; circles indicate MISs; lines indicate direct link (e.g. web service access); dotted lines indicate indirect link (batch process, CDs etc.). Arrows indicate where information flows in one direction or two directions. In Brazil, two-way flow of information is only achieved between Cadastro Único and Bolsa Família. All other programs receive data through ad hoc links and do not share their beneficiary lists back.

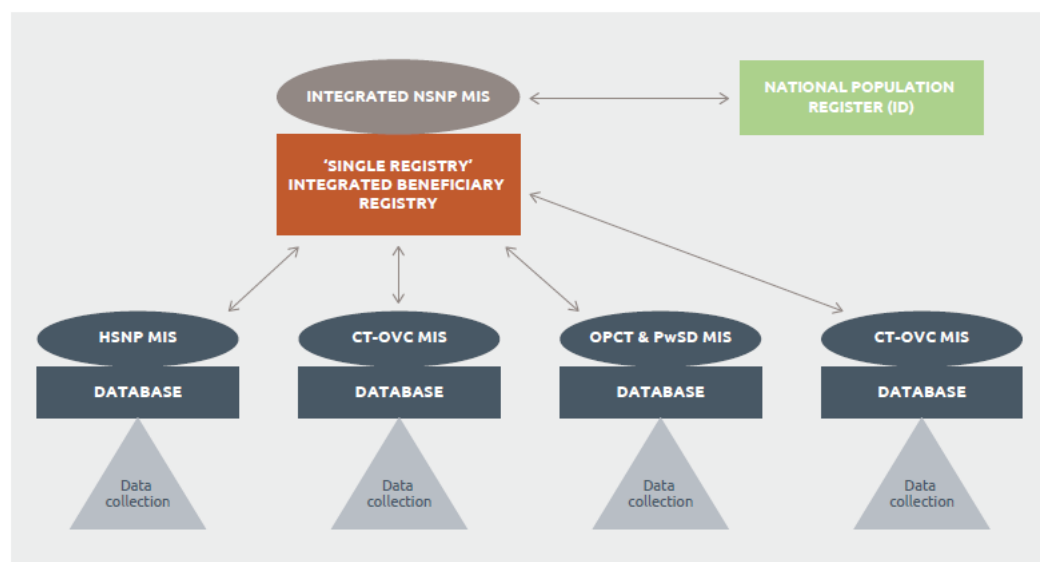
b) Single Registry (Kenya)

Kenya's Single Registry can be classified as an interoperable SPIS with a web-based reporting interface that provides a platform where common and essential information across five social assistance programs. The system holds information on all the beneficiaries of the national social protection system, and is continuously and automatically updated by individual social protection program MISs. In May 2016, the Single Registry was populated with information on 883,000 beneficiary households (approximately 3.7 million individuals) out of a population of 44 million, equivalent to 8 per cent of the national population [29]

As shown in the below map, the system receives beneficiary information from five social assistance programs and is linked with national population register for the purposes of data

verification. Vertically, it provides coordination, oversight and integrated monitoring and evaluation across programs; and horizontally, the system helps to avoid double targeting and aggregate beneficiary data across the five programs [29]

Figure 16 Programs that form Kenya's Single Registry



Source: Developed by authors based on discussions with the Ministry.

Note: Boxes indicate databases; circles indicate MISs; bold lines indicate direct link (e.g. web service access); arrows indicate information flowing in both directions. In the case of Kenya, information flowing from the integrated beneficiary registry to the programs is on duplicate beneficiaries across programs (data is collected by individual programs, then shared and cross-checked against the 'Single Registry'.

2.3.2. Social Protection MIS in Ethiopia: Policy and Practice

Social protection is the service that has constitutional foundation in Ethiopia. This is also well acknowledged in the relevant policies and strategies of the country. For example, one of the objectives of the national social protection policy is to establish a system to identify the number and types of the vulnerable to chronic food insecurity and include them in rural and urban productive- and social-safety net programs. In line with this, the policy vows to establish a management information system for effective and efficient implementation of social protection programs and communicate the achievements of the desired outcomes and impacts [8]

The national social protection strategy developed in 2016 further sets out how the central registry system looks like. According to the strategy, the Single (National) Registry System (SRS) also called it the Common (or National) Beneficiary Registry System (CBRS) would be available at woreda and kebele levels, and used for beneficiary selection, payment and monitoring purposes [11]. In addition, the strategy underlines the need for information exchange between safety net and humanitarian actor staff on the status of the shock. The

government hopes that such system would also help to promote common standards and systems, and harmonize targeting system as well [11]

From the above provisions, what is clear is that Ethiopia's intention is to establish some sort of MIS at central level. But, the type of MIS, whether it is integrated or interoperable is not clear. For example, it states that the system would collect information necessary for the targeting of all programs from households as part of a collaborative exercise and use it for targeting of all programs. This shows that the system would be at least be an interoperable one, i.e. one that links the two largest social protection programs.

However, such envisioned MIS is still far from the reality. The study made by OPM categorized countries in to four based on their status of SPIS. The first ones are those that have developed integrated social registries, while the second being those having an integrated beneficiary registries. The third ones are countries having only independent program beneficiary registries, and finally are countries which are just starting the development of any of such comprehensive systems [12]. According to the data from the World bank, Ethiopia along with other 18 Sub-Saharan African countries fall under the fourth category, struggling to set up an integrated SPIS [29].

2.3.3. Ethiopian Electronic Government Interoperability Framework

The EeGIF (Ethiopian Electronic Government Interoperability Framework) is developed in 2019 on the basis of the ENEAF (Ethiopian National Enterprise Architecture Framework) which was developed before. The EeGIF is a governance and compliance that focuses on the issues that are pertinent to interoperability and on issues of compliance [21]

In order to fully operationalize the framework, the document outline the governance guiding principles, the structures and roles of responsibilities of different actors. The framework also set out some key guiding principles to ensure interoperability between and among government-employees- citizens, businesses. The framework also adopts general policies; data and metadata policies, security policies and application and technology policies [21]. This are also similar with the principles set out in the European Interoperability Framework (EIF) [34]

In addition, the framework outlines key interoperability guiding principles, including multilingualism, user-centricity, participation, inclusion and accessibility, interoperability, market support, scalability, delivery infrastructure, openness, reuse, international standards, delivery infrastructure, technology neutrality, access and security, privacy. The framework also describes steps, roles, structures in compliance [21].

2.3.4. Existing MISs for PSNP and HFA Programs and Potential Linkage

Productive Safety Net Program of Ethiopia is one of the largest safety net program in Africa both in its scale and beneficiary coverage. It was launched by GOE in 2005 with the aiming to eradicate extreme poverty and promote food security in the country. The program has been implemented in 384 woredas across six regions of the country, reaching up to 8 million population. The fifth phase of the program (2020-2025) is currently underway [34]

One of the unique nature of PSNP V is it has set Shock-responsive safety net as one of its components. This is a mechanism where the program reaches out to disaster affected PSNP target population as well. According to the program document, the program would shift to a more pre-emptive approach to address the needs of the extreme poor in drought prone woredas. As such, it would encompass improved early warning systems, standard operating procedures for scale-up, and a drought response plan. In addition, PSNP V actively engage in facilitation, follow up, and monitoring of linkages to available services (case management) to its clients [34]

Interoperable SPIS requires linkage with MISs of other government services which one of these is MIS of humanitarian services, also called Disaster Risk Information System. SPIS and DRIS have much in common due to both serves affected/ disadvantaged communities and data from one is used to inform the other. Hence, institutions implementing these programs should work together as of the targeting phase.

In the Ethiopian case, the MOA and the EDRMC are the public bodies coordinating PSNP and HFA programs in the country. Cognizant of this, the social protection policy and strategy underlined the need to link PSNP with that of the humanitarian interventions. Specifically, it is set to harmonize the targeting system of the two programs which essentially starts with making the two institutions work together at least.

According to several researches and reports, MOA uses PASS and RPASS to manage data on the delivery of cash and food assistance to the beneficiaries of PSNP. PASS was mainly aimed at supporting cash payments for beneficiaries. It was later revised as RPASS and this was supposed to have full household information. However, this was not possible in all woredas and the system still largely serves payment and public work activities, meaning the existing PSNP MIS couldn't serve other tasks like registration, targeting, grievance handling, exit and graduation as intended. Of course, there is renewed effort by MOA to set up an MIS and this is being rolled out in 50 pilot woredas [13].

On the other hand, EDRMC uses Commodity Allocation and Tracking System (CATS) to track commodities distributed to beneficiaries. This was largely donor driven and is aimed at tracking supply of commodities from donors all the way to beneficiaries. It is thus not beneficiary centered and not easy to be integrated with PSNP MIS [18].

The study made by OPM on the targeting system of PSNP and HFA reported a serious gap in targeting error and grievance redressal mechanisms for both PSNP and HFA programs in geographic and household targeting. Particularly, the study came up with findings that there are exclusion and inclusion errors almost in all target regions. Besides, the study underlined absence of synchronization between institutions involved in implementation of PSNP and HFA programs. With that backdrop, the study strongly recommended establishment of an MIS that supports targeting of both PSNP and HFA programs as well as other social assistance interventions [13]

Of course, there are recent efforts to strengthen coordination between MOA and EDRMC in implementation of their respective programs and harmonize their targeting systems too. However, this is only starting and in particular harmonizing the MISs system remains to be a challenge.

2.4. Related Research Works on SPIS

Valentino Barca is among the pioneers in studying SPIS. She has succeeded in establishing SPIS as a distinct type of MIS with typical features. In her various publications, she underlined the immense benefit of SPIS in tackling coordination and inclusiveness in social services. She at the same time highlighted the trade-off and challenges and risks associated with SPIS mainly in developing countries. According to her, two overlapping approaches to setting up SPIS can be adopted by countries. The first integrating beneficiary registry (program MIS) and second centralizing social registers (national level MISs). But, both types of SPIS can be achieved by ensuring the different MISs are interoperable at the least.

In addition, Barca well researched the SPIS of dozens of countries and documented good practices in SPIS across the globe. Based on this, she put policy and implementation level lessons that low and middle income countries can possibly adapt in establishing a functional SPIS. Her final remark; however, was that opportunities and challenges are determined by country-specific objectives, as well as institutional, operational and technological considerations, which in turn determine the specific approach to setting up the SPIS [22].

2.4.1. Research Gap in Interoperable SPIS in Ethiopia

Generally, interoperability research is a recently emerging sub-discipline in the field of information science. However, in the case of Ethiopia, it is not only interoperability, Social Protection Information System (SPIS) is not well studied itself. Though there are limited studies made on health MIS, their implication could not be the same for social protection MIS which has its own peculiar features. Those few researches conducted on interorganizational MIS are also based on HMIS and thus have limited practical reference for this proposed study either.

The following are some of researches conducted on interoperable and integrated MIS that are some relevance to the proposed research

a) “Data Exchange Interoperability Framework for Laboratory Information System (LIS) and Electronic Health Record (EHR) of two Hospitals in Addis Ababa

This is an IS interoperability research conducted in Addis Ababa University in 2013. Its major objective was to propose data exchange interoperability framework for the existing two MISs called, LIS and HER in two hospitals in Addis Ababa. Accordingly, the study how lack of interoperability and coordination caused fragmentation of systems and data redundancy on eHealth applications in the Hospitals. Based on semantic interoperability framework, that, it proposed and tested data exchange interoperability framework between LIS and HER, and reported the acceptance of the framework by users [23]

This may be the most closely linked research with the current proposed study for the fact that it focused on interoperability of information system. However, it was conducted in the same organizations/ hospitals where integration could even be more possible than interoperability [23].

b) Architectural Framework for Information Integration: Case of Organizations Working on Water, Hygiene and Sanitation in Ethiopia”

This is a masters thesis conducted in Addis Ababa University in 2013. The study mainly aimed at proposing an architectural framework that can be considered for integrating the data produced by governmental as well as nongovernmental organizations working on Waster, Sanitation and Hygiene program. Accordingly, the study proposed an indicator based architectural framework to guide the development of an Integrated WASH information system [35]

The study based the existing WASH implementation Framework (WIF) which is also agreed by all development actors implementing the national One WASH program. This had given a good opportunity to align the integration framework with existing implementation framework of the program. As per the study, the proposed framework was also was discussed with selected respondents for checking its validity and the overall reaction of the respondents was found to be positive [35]

The study compared centralized and distributed architecture development approaches. But, it was not clear with which specific architecture type the framework was developed, the availability of an agreed implementation framework seemed to be a good opportunity to develop a more practical in architectural framework that all implementors can easily accept [35].

c) Developing Patient Information Record System Integration framework for Ethiopian Hospitals

This is again a research focusing in the health sector conducted for Addis Ababa University in 2020. The main objective of the study was to develop patient information record integration framework of health information systems for two private hospitals. The study employed The open group architecture framework (TOGAF) and finally proposed the framework accordingly [36]

Given TOGAF is uniquely placed for IS studies in the health sector, it may not be surprise to find it acceptable and workable in the case of the research too. However, given the background of the two institutions in this proposed study, there may not be much findings worth to refer to from the research [36].

As discussed above, there is generally significant knowledge gap in terms of SPIS in general and interoperable SPIS in particular. In addition those few available studies were based on either TOGAF or other general frameworks, and no research was done based on AIOS in any of the sectors or organizations. Given coordination, collaboration and communication is a critical challenge in the public arena, the proposed research would contribute to the research gap and possibly to practice of interoperability.

2.4.2. Challenges in SPIS in Ethiopia

Ethiopia has embarked on establishing a central registry for its social protection programs. However, this was not achieved yet and the country is still struggling to set up an MIS at least

for PSNP which has larger coverage both in terms of geography and population, hoping this would pave the way to one centrally managed SPIS serving all other social assistance programs as well. In fact, there continue to be ample opportunities to realize the envisioned MIS.

To start with, having a policy backup for establishment of such system could be the first opportunity. According to Barca, enabling policy environment for an integrated SPIS is a key starting point. Given the GOE clearly articulates the need for such registry in both the policy and strategy document, this could be a good opportunity to work towards it. The fact that MOA is taking concrete measures to set up MIS for its PSNP in line with the policy and strategies could be an encouraging step as well.

The other opportunity could be the presence of nation wide social protection programs namely PSNP and HFA. These two programs reach out to millions of population and covers hundreds of woredas across regions and have overlapping both geography and potentially in terms of household as well. So, setting up an MIS for the two programs and harmonizing their systems could be a great step forward towards central and integrated SPIS in the country [13].

The GOE recently enacted a national identity service proclamation, and established an institution leading on this. As evidenced by different studies, having a national identity system is one of the success factors of an integrated SPIS. In that regard, the recent efforts on this and specially the priority given for PSNP woredas could be another opportunity [37].

On top of all, learning from experiences of countries which have already had an effective SPIS could be an advantage for beginners like Ethiopia. This could help to know which type of SPIS best work for Ethiopia and how to capitalize on already existing MISs, and most importantly on how to integrate different program level and national MISs to have a functional SPIS.

The absence of national level registry and/or MIS (Management Information System), resource constraints, the lack of a working grievance management and handling system, and issues of targeting, especially in pastoral areas [4] were repeatedly reported by various studies as key bottlenecks [38].

At the same time, there could be numerous challenges as much as we have the opportunities. The first challenge relates to the overall capacity of the government. This could be explained in terms of budget staff and infrastructural availability. Different researches show that these are key determinants to have an effective SPIS. However, this is expected to be among the thorniest issues in Ethiopia.

Structural challenge could also pose a challenge in establishing the system. This is mainly related to who to lead the SPIS and how the different stakeholders to get involved in the development and running of the system. Given the multi-sectoral nature of social protection programs and the current government structures, availing one centrally managed SPIS could be challenging.

2.5. Chapter Summary

In the chapter, we discussed the conceptual background of key terms related to SPIS, theoretical underpinnings of SPIS and also drew empirical evidence on SPIS in general and interoperability in particular at the global and in the Ethiopian Case. The chapter highlighted that interoperability research is relatively new sub-field of information science. It is least studies globally and least used especially in developing countries. Social protection information system in general is said to be no-existent in Ethiopia and interoperable systems in particular are not evident in the country. Though there have been very few studies conducted on interoperable framework on health MIS, they have not been translated into action. In sum, there has been critical gaps both in terms of knowledge and practice on interoperable IS in Ethiopia in general and in the social protection sector in particular.

CHAPTER THREE:

RESEARCH DESIGN AND METHODOLOGY

Research design is a strategic framework that serves as a bridge between research questions and the execution, or implementation of the research strategy. Research design is an approach that a researcher uses to conduct a scientific study. It thus constitutes the blueprint for the collection, measurement, analysis of data, interpretation, and reporting of conclusions [39].

Accordingly, this chapter presents the research design and methods that was used to answer the research questions and achieve the research objectives. It starts by introducing research approaches, and research strategies planned for the study and the study target organizations,. Then, it describes the data collection methods, instruments and techniques to be used. It also discusses the data analysis methods and procedures.

3.1. Research Approaches

The research approach refers to the plan and procedure of a research that consists of the steps of broad assumptions to the detailed method of data collection, analysis, and interpretation. The research approach is mainly determined by the nature of the research problem being addressed [40]

The research intends to understand how the MIS practice looks like for two largest government programs, and then propose an architectural framework for integrating the MISs of the programs.. Hence, in line with the research questions and objectives, the research employed qualitative research methodology. This is because such research approaches help to understand the situation in-depth and where the phenomenon is not yet well explored [41]. So, the research relied on qualitative data about the existing MISs and their functioning that came through interviews, observations and document review.

3.2. Research Methodologies

Research methodology refers to a science of studying how research is done scientifically [42]. Basically, research methodologies fall under two broad category: Those used for behavioural researches and those used for information science studies. The later is also called design science research methodologies. Given the research looks into existing MISs practices and propose architectural framework for interoperability, it primarily employed design science methodologies backed up by qualitative methodology.

3.2.1. Design Science Research Methodology

The research also used design research methodology. This is because the methodology is focused on the creation and evaluation of innovation information technology artifacts [43]. Accordingly, the research followed six steps developed by Peffers et al: Problem identification and motivation, objective of the solution, design and development, demonstration, evaluation and communication. This was because, as compared to other models, the model is the most widely referenced model and offered four possible entry points: problem-centered initiation, objective-centered solution, design and development-centered initiation, and client/context initiation. These entry points are applicable to the problem under study.

a) **Problem Identification and Motivation**

This is the first stage in design science research methodology where one identifies the research problem and gets the motivation to find a solution to it [43]. The research is motivated by a previous research which developed interoperability framework for different MISs used by various hospitals in Addis Ababa. This stroke a thought in the researcher's mind that PSNP and HFA, the two closely related social protection programs in Ethiopia can also be interoperable. From pragmatic point of view too, the research has identified the problem which is lack of data sharing between the two social protection programs and plans to propose an architectural framework for interoperating the two information systems. The research also justified the solution of the problem in that the proposed framework would interoperate the two systems and be a basis for advancing to integrated social protection information science in Ethiopia.

b) **Objective of the solution**

The objective of the solution is to develop and implement an architectural framework that would ensure data exchange between the two information systems by making them interoperable. The researcher believes that the proposed solution would, if implemented by the concerned government actors, would provide the solution for the current data related problems.

c) **Design and Development**

The proposed study intends to create architectural framework which was used to create interoperable MIS between the two institutions. Specifically, the study used the Architecture of Interoperable Information System (AIOS) Framework described in section 3.4 below.

d) Demonstration

Demonstration is the stage where the researcher checks how the proposed artifact, the framework in this case the framework solves the identified problems. Hence, the draft framework was hypothetically demonstrated to key MIS experts of the two institutions and comments were received for improvement.

e) Evaluation

After demonstration, a questionnaire focusing on four dimensions, i.e. the utility and applicability of the framework, consistency with organization, the content of the framework, and usefulness of the framework was developed and administered to MIS professionals of the two organizations and IT people familiar with such interoperable system. The outcome of the analysis was be a base to see the acceptability and potential workability of the proposed framework.

f) Communication

Once, the proposed framework is evaluated, the researcher communicated all concerned actors, mainly the two government institutions leading the two social protection programs. A brief note on the importance of the proposed framework and requirement for effective implementation was prepared and disseminated to all stakeholders as well.

3.3. Description of Study Organizations

3.3.1. Ministry of Agriculture (MOA)

The Ministry of Agriculture (MOA) is a federal level institution mandated to oversee the agricultural and rural development works in the country. Founded in 1907 during the reign of Menelik II, the Ministry is one of the oldest government bodies in the country (MOA website). It is also one of the largest ministries in terms of its structure and scope of mandate covering; among others, food security, forest and wildlife resources, water use and small-scale irrigation, agriculture and rural technology. The ministry also administers federal level research institutes, agricultural TVETs, cooperative/ marketing agencies and authorities [44].

As part of its primary mission, the Ministry has been implementing a program called Productive Safety Net Program (PSNP) as of 2005, and is currently in its fifth phase (2020-2025). The main objective of the program is to ensure food security of highly food insecure households in drought prone woredas and mitigate the effect of disasters on them. The program was started in about 190 woredas in 2005 and now the number of target woredas reached 485 across 7

regions: Afar, Amhara, Oromia, Sidama, Somali, Southern Nations, Nationalities, and Peoples' Region, and Tigray. The program's clients has also grown from 262,000 people in 2005 to 8.3 million in 2018 [19], making it one of the largest safety net programs in the world [45].

The Food Security Coordination Office (FSCO) of the Ministry is responsible to coordinate the program. The unique nature of the program is that it has been supported by several international donors, including, but not limited to UNICEF, WFP, the World Bank, UKAID/FCDO, USAID, and GAC. Dozens of international and national NGOs are also engaged in implementation of the program [34]

Given the size of its clients and the reporting needs of donors, the program has developed a Social Protection Management Information System (SPMIS) as of its fourth phase. The main objective of the system is for effectively targeting beneficiaries, registering, monitoring program delivery and fund transfer, and addressing grievance redressal for the program. It was hoped that the system, by providing an integrated platform, would ease coordination among different partners and help leverage data use for evidence-based policy decisions as well [17].

The SPMIS is an end-to-end automated system developed by using scalable architecture. It has online and offline mode of access with multilingual support. The system is also mobile ready, and support both centralized and decentralized implementation and has SMS based notification. Though the level of functionality of the system remains questionable, it is already piloted and being implemented at least in some woredas where there are woreda net [17].

3.3.2. Ethiopian Disaster Risk Management Commission (EDRMC)

Ethiopian Disaster Risk Management Commission was established as Relief and Rehabilitation Commission (RRC) in the aftermath of the 1973 famine. The Commission currently operates under the Office of the Prime Minister, and its prime mandate is to prevent natural and man-made disaster, increase disaster preparedness and mitigate their impacts when occurred. In addition, the Commission is responsible to generate early warning information and shares to MOA/ PSNP and other partners for disaster preparedness and response works [46].

The Commission is responsible to coordinate humanitarian food assistance program which is a life-saving intervention. Like in the case of PSNP, HFA is also supported and implemented by dozens of international and national donors. The program supports tens of millions of people across disaster hit woredas every year on temporarily basis [9]. For example, currently the Commission is working to reach out to more than 20 million Ethiopians who are affected by drought, flooding and conflict across various regions of the country [47]

The Commission has an MIS called Commodity Allocation Tracking System (CATS) designed to link the different donors' supply chain so that commodities received from a particular donor can be tracked all the way to the beneficiary. The aim of the CATS is to improve the visibility of commodities as they move from the donor to the beneficiaries, through the existing supply chain and thereby improving commodity management and donor reporting as well [48].

3.3.3. Linkage between the two MISs

PSNP V and HFA programs are both nation-wide social protection programs, and thus have much in common. In some instances, they share the same geography which has at times led to potential overlapping of beneficiaries and duplication of efforts by donors. As a result, the GOE has made strategic direction for the two programs to coordinate their operation [10] [13] [18].

With that backdrop, the PSNP, as of its fifth phase, has integrated shock responsive element into the program which was previously managed under HFA Program. As a result, MOA is today responsible to provide humanitarian assistance to both PSNP and non-PSNP clients within PSNP woredas as per the early warning information received from EDRMC. In responding to disasters, the MOA also uses commodities from EDRMC's warehouses near the target woredas [9] [18]. This shows that there is high degree of interdependence between the two programs, requiring exchange of data on regular manner, and having an interoperable MIS would be an ideal solution for the problem.

Below is summary of the key similarities and dissimilarities between MISs of the two social protection programs.

Table 3: Summary of features of the two MISs

Parameter	Similarities and dissimilarities between the two MISs	
Nomenclature	SPMIS (Social Protection Management Information System)	CATS (Commodity Allocation and Tracking System)
Owner of the MIS	Ministry of Agriculture	Ethiopian Disaster Risk Management Commission
Purpose	Tracks beneficiaries from registration to exit	Tracks commodity distribution from warehouse down to household level
Center of focus	Beneficiary centered	Commodity centered
Driving factor	Donor reporting and compliance	Donor reporting and compliance

Time dimension	Tracks permanently supported beneficiaries for years	Tracks temporarily distributed food aid for few months
Key actors	Involves several funding and implementing NGOs	Involves several funding and implementing NGOs
Linkage with other national MISs	No	No

3.4. Data Collection Methods and Tools

The research used drew both primary and secondary data from different sources. Primary data came through in-depth interview and observation; whereas document review was used to generate secondary data for the study. The data collection methods and tools are described as follows.

3.4.1. In- depth Interview

Qualitative interview attempts to understand the world from the subject's point of view, to unfold the meaning of people's experiences, to uncover their lived world before scientific explanations. It provides a method for data collection rich and detailed information about how individuals experience, understand and explain events in their lives [42]

Semi-structured interview was the main source of data for the research because such interview form provide freedom for a researcher in terms of content and structure. In particular, the researcher employed an in-depth interview technique. The in-depth interviewing technique involved conducting intensive individual interviews with a small number of respondents to explore their perspectives on a particular idea, program, or situation. In addition to the flexibility it gives to the researcher, such method is very suitable to gather rich data from relevant subjects in various situations as well [41].

The researcher is convinced that problems concerning Social Protection Information System can be best understood by the interaction between the researcher and other group of participants. In line with that, in-depth interviews was conducted with program managers and MIS professionals who were directly involved in implementing the program managing data related to the government's PSNP and HFA programs.

3.4.2. Observation

Observation is another data collection method used to gather data which may be difficult to gather through interviews. According to Dawson, observation is a valuable and rewarding

method for qualitative inquiry [41]. Hence, the researcher moved around different offices managing MISs to see what type of data is collected and entered, how reports were produced and used to support the key schemes of the program. An observation checklist was prepared to guide the process.

3.4.3. Document Review

Document analysis is a systematic procedure for reviewing or evaluating documents both printed and electronic (computer-based and Internet-transmitted) material. Like other analytical methods in qualitative research, document analysis requires that data be examined and interpreted to elicit meaning, gain understanding, and develop empirical knowledge [49]. It is a low-cost way to obtain empirical data as part of a process that is un-obtrusive and non-reactive. Often, documentary evidence is combined with data from interviews and observation to minimize bias and establish credibility [50]

As one of the objectives of the research is to assess the existing MISs and their functioning, organizational documents provide a ready to use information for understanding of the case under investigation. In the case of this study, such documents can provide additional information over interviews about historical records and events and also be used to triangulate data collected through interviews and observation. Accordingly, the below documents were referred for the study

- PSNP and HFA program documents
- PSNP and CATS MIS user manual, forms, tools, templates
- MOA/ PSNP periodical (annual and quarterly) reports
- Historical records on previous PSNP and HFA programs
- Donor (mainly World Bank) reports
- PSNP and HFA program evaluation/ impact assessment reports
- National digital identity service records/ reports
- Any relevant national/ sectoral information systems

3.5. Target Population and Selection of Respondents

3.5.1. Target population

The study was carried out within Ethiopia and the targeted organizations of the study are the Food Security Coordination Office (FSCO) of Ministry of Agriculture, and Ethiopian Disaster Risk Management Commission (EDRMC). The population of this study were the employees

of these organizations. The research particularly focused on the staff of information technology, computer based and information archiving departments in those institutions because the study deals with existing MISs and their functioning. Those experienced staffs directly involved in leading, implementing and data managing were the targeted populations.

3.5.2. Selection of Respondents

Scholars agree on the importance to carefully select naturally acute observers and well-informed people about a setting or situation so that they assist the researcher to deeply understand the phenomenon [51] Therefore, key respondents who had dominant role, status and experience in PSNP and HFA programs were included in the study to ensure that highly pertinent and relevant data is gathered.

The study doesn't involve sampling and statistical generalization since the selected cases are not sampling units [51]. Cases are selected for doing deeper investigation. According to Yin, when an individual is selected as a case, it is not equivalent to a single respondent in a survey or a single subject in experiment. Regarding the selection of participants we used purposive, non-random sampling technique mainly, snowballing in order to pick appropriate respondents for the in-depth interview.

The study also applied the criteria of theoretical saturation which refers to a sampling decision that directs the researchers to extend their sample until they are confident that no additional data can be found that contributes to the development of properties of a category. In other words, it is bringing new participants continually into the study until the data set is complete, as indicated by data replication or redundancy. Researchers should stop adding samples when theoretical saturation is reached (i.e. the point at which incremental learning is minimal because the researchers are observing phenomena seen before) [51] [52].

Therefore, based on the stated principles of theoretical sampling and theoretical saturation, the study included 9 in-depth interviewees, i.e. 5 from FSCO of MOA, and 4 from EDRMC, potentially with flexibility to add more until the point of data saturation. Specifically, both program technical persons (domain experts) and MIS professionals (system administrators) were purposively selected based on their proximity and experience in working on the MIS of the two programs. To make sure that all perspectives are included in the study, both women and men were intentionally sampled for the study.

3.6. Data Analysis and Presentation

Data analysis is the process of evaluating data using analytical and logical reasoning to examine each component of the data provided. Flick defines data analysis as the process of classification and interpretation of linguistic (or visual) material to make statements about implicit and explicit dimensions and structures of meaning-making in the material and what is represented in it [42].

Data analysis and presentation is a critical step in this research process. During the interviews, detail notes were taken and immediately transcribed using informants' own words. Voluntary informants were also tape-recorded if permission is obtained and were immediately transcribed using the informants' own words. Notes from observation were also taken.

The data was analyzed in light of the research questions and the conceptual framework. In line with this, a qualitative thematic analysis technique was used to clearly understand the themes or patterns of the phenomenon under study. Besides, logical analysis and work flow analysis was used to identify areas of collaboration between the two MISs. The researcher specifically adopted the non-linear phases developed by Braun & Clarke which has six steps: becoming familiar with the data; generating initial codes; searching for themes, reviewing the themes; defining and naming the themes, producing the report [54].

In order to ensure the reliability and validity of the study, triangulation technique was also employed. Accordingly, data from in-depth interview, observation and documentary sources were cross checked and further scrutiny or data reconciliation was done to draw reliable findings.

Then the result of the analysis was made to design the framework. The proposed framework was evaluated through expert analysis from both target institutions. This was done on the basis of four key dimensions: i.e. the utility and applicability of the framework, consistency with organization, the content of the framework, and usefulness of the framework. Questions to this effect were prepared and discussed with mainly MIS professionals administering the existing MIS.

CHAPTER FOUR:

ANALYSIS, FINDINGS AND DISCUSSION

This chapter discusses the responses from the in-depth interview conducted with system developers and system users of the existing MISs of the two programs as well as observation conducted on the two systems. The chapter starts with presenting the background of respondents and then discusses the strategic direction of the government on harmonization of PSNP and HFA programs. This is followed by the design and functionality of the existing MISs of the two programs, and then the functions and processes involved in the implementation of the programs. The indicators and type and source information that the two MISs are collecting including the analysis and reporting processes as well as the information technology used is discussed. The challenges of the existing MISs were also discussed in this chapter.

4.1. Background of Respondents

Data was collected from administrators and users of the MISs used for the two programs. System administrators are those who are MIS professional directly involved in technically managing the system, whereas system users are those program staff who are non-MIS staff working on thematic areas of the programs. Accordingly, a total of 11 staff were approached for the study, of whom 9 staff were interviewed from the MOA and EDRMC combined. Five of them were from MOA, while the rest were from EDRMC. The background of the respondents is shown in the below table:

Table 4: Profile of Respondents

No	Population Characteristics		MOA (PSNP)	EDRMC (HFA)	Total	Remark
1	Sex	Male	4	3	7	
		Female	1	1	2	
		Total	5	4	9	
2	Highest Education	No Degree	0	0	0	
		First Degree	3	2	5	
		Second Degree	2	2	4	
		Total	5	4	9	
3	Years of Experience	5 years & below	0	0	0	
		5-10 Years	1	1	2	
		10 Years and above	4	3	7	
		Total	5	4	9	
4	Roles	MIS administrators	2	2	4	
		MIS Users	3	2	5	
		Total	5	4	9	

As shown in the above table, respondents of the study, from both institutions/ programs are well educated and have long years of experience. Both system developers and users were also fairly represented in the study. However, the study had less female respondents. The data shows that key personnel familiar with the MIS are well involved in the study

4.2. Qualitative Data Analysis and Findings

As stated in chapter three, the study followed thematic analysis as the main analytical method. In line with this, the overall analysis task was categorized into three basic topics:

-  Harmonization of the two programs and their MISs
-  The information needs and functionality of the existing MISs (RQ 1)
-  The nexus between the two MISs (RQ 1)
-  Interoperability architectural framework adaptation (RQ 2 & RQ 3)

The specific topics under each main topic is given below

No	Main and sub-topics
	Harmonization of the two programs and their MISs - Perspectives on harmonization of the two programs and their MISs
	The information needs and functionality of the existing MISs (RQ 1) - Design and functionality of the two MISs - Information requirements of the two MISs - The data management practice for the two MIS
	The nexus between the two MISs (RQ 1) - Collaborative businesses of the two programs - Technical operability of their MISs
	Interoperability architectural framework adaptation (RQ 2 & RQ 3) - Issues on Data Sharing and Interoperability - The proposed interoperability architecture

The data that was collected from 9 respondents was analyzed based on thematic analysis method. Accordingly, first, the researcher had made himself familiar with the data collected and got deeper understanding of the subject matter. The interviews that were transcribed by the

researcher were stored in plain text as a softcopy and hard copy. Moreover, the transcribed record was prepared and organized for easy data analysis. The initial codes were generated then those codes were categorized to form a theme. Through rigorous analysis, 7 basic themes had been identified from the interview transcript and these were:

Theme 1: Perspectives on harmonization of the PSNP-MIS and CATS,

Theme 2: Design and functionality of the two systems

Theme 3: Information requirements of the two MISs

Theme 4: The data management practice for the two MIS

Theme 5: Collaborative Businesses of the two programs

Theme 6: Technical operability of their MISs

Theme 7: Issues on Data Sharing and Interoperability

Each of the above themes are presented and analyzed below

Theme 1: Perspectives on harmonization of the PSNP-MIS and CATS,

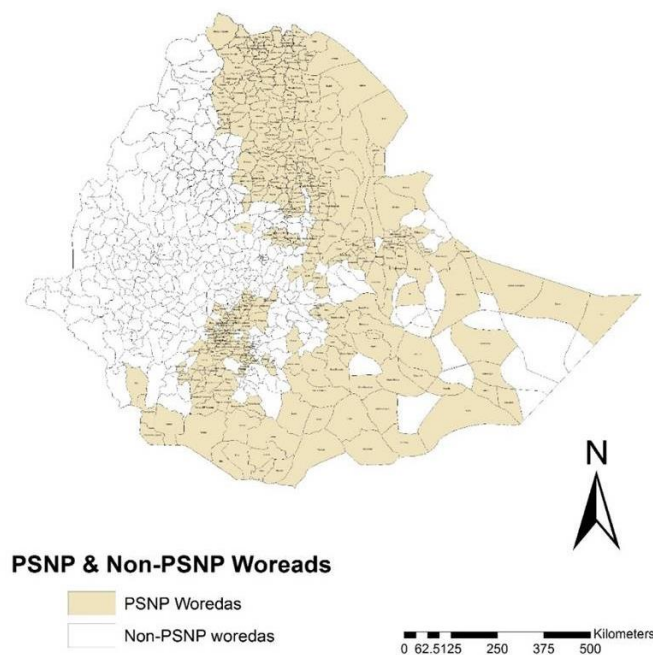
Prior to going into the details of the two programs and their MISs, it is imperative to understand the nature of the two programs. According to data sources, both PSNP and HFA pass through similar paths on the course of their humanitarian services. Almost all respondents also agree on the common features of the two programs. At the same time, the two programs have unique services which differ them one another, and the way they provide services is also different in some cases.

According to one respondent,

The HFA was once under MOA with food security. This was an ideal structure for me. But, now they are under two different organizations. That is why harmonization of the two programs has become the prime agenda and too difficult to achieve too.

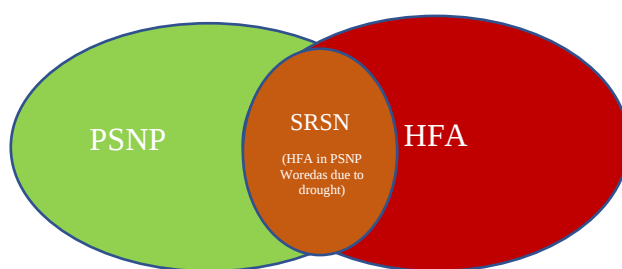
As the two programs are a bit complicated and have much to share, it is quite necessary to understand how the MOA and EDRMC collaborate one another and implement the programs, in order to propose an architectural framework for the envisioned interoperable MIS.

Figure 7: Operational Woredas of PSNP and HFA Programs



According to informants, a “one operator per woreda” modality is recently agreed by the two institutions, meaning it is either PSNP or HFA that would operate in a single woreda. Of course, there still remains some challenges in terms of fully realizing this. However, as things stand now, MOA/ PSNP operates in the 485 PSNP target woredas including reaching out to non-PSNP beneficiaries in these woredas in case of emergency (Please see the map above for PSNP and non-PSNP target woredas). Whereas EDRMC operates in non- PSNP woredas whenever there is any kind of emergency in the woredas.

Figure 8: Relationship between PSNP and HFA Programs in PSNP target woredas



To see the relationship of the two programs closer, the collaboration between the two organizations lies in the SRSN component of PSNP (Please see the map above). This is the emergency element where PSNP additionally supports PSNP beneficiaries in case of shock so that they remain resilient in case of the disaster. However, the alignment of the two programs

goes deeper. The below table depicts how the two programs operate across woredas under different disasters:

Table 5: Comparison of PSNP and HFA Programs

Organization	Program	Kind of Disaster	Intervention woreda	Target People
MOA	PSNP (SRSN)	Drought	PSNP woredas	PSNP beneficiaries
				Non-PSNP beneficiaries
EDRMC	HFA	Drought	Non-PSNP woredas	Non-PSNP beneficiaries
		Other disaster	PSNP woredas	PSNP beneficiaries
				Non-PSNP beneficiaries

As shown in the above table and also confirmed by informants, MOA is only concerned with the issue of food security and operates through SRSN when there happens drought in its target woredas. On the other hand, EDRMC's HFA is concerned with any kind of disaster including drought. However, in terms of geographic presence, MOA operates only in PSNP target woredas and in case of food security. Whereas EDRMC operates in non-PSNP woredas in case all disasters, but intervenes in PSNP woredas only when the disaster is not drought.

The researcher tried to understand the extent harmonization of the different social protection programs is government's priority. In this regard, documentary sources reveal that harmonization of the different social protection programs run by state and non-state actors has long been the agenda of the Government of Ethiopia (GoE). As clearly put in the policy, the government underlined the need for integrating all social protection services in the country and develop one integrated central registry at national level. According to the policy, the envisaged MIS would allow for an identification and targeting of beneficiaries depending on their geographical location, family size, and need for particular benefits [8].

The national social protection strategy developed in 2016 further also sets out how the central registry system looks like. According to the strategy, the Single (National) Registry System (SRS) also called it the Common (or National) Beneficiary Registry System (CBRS) would be available at woreda and kebele levels, and used for beneficiary selection, payment and

monitoring purposes. In addition, the strategy underlines the need for information exchange between safety net and humanitarian actor on the status of the shock [11].

As part of this effort, the MoWSA (the then MOLSA) initiated a national program to instrumentalize a nation-wide integrated Social Protection Information System (SPIS). As shown in the below map, the envisioned national system was set to integrate MISs of the different social protection programs including EMIS (Education MIS), HMIS (Health MIS), PMIS (Prosecution MIS), PSNP-MIS, Urban PSNP MIS, among others.

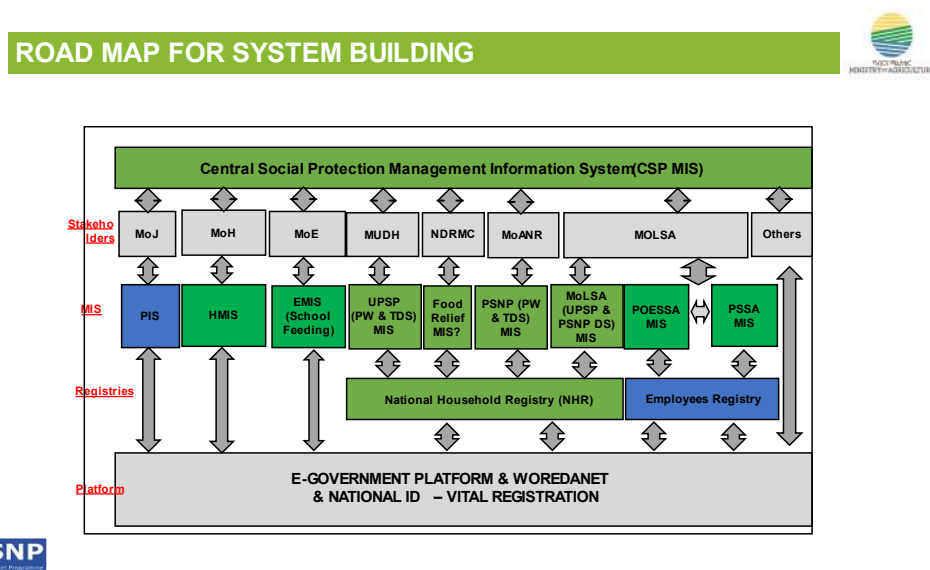


Figure 9: The envisioned Integrated Social Protection Information System in Ethiopia

According to one informant who was part of the then system development team,

Efforts have been made to instrumentalize an integrated MIS for the different social protection as of 2016. However, the envisioned system has never been materialized. So, each individual Social Protection program implementing organizations were advised to strengthen their respective MISs and then to collaboratively work towards one integrated system.

Another MIS expert also asserted this fact and added:

Due to the failure to realize an integrated MIS for social protection programs, the two organizations (MOA and EDRMC) turned their focus to align their data management systems. This was because linking MISs of the two largest programs would be costly and there is already an common understanding between the two organizations.

Another informant had also this to say:

It has practically been a huge challenge for the reason that the two organizations are independent and autonomous. The competition for resources channelled by different donors is also what drives the government to tie the two organizations under harmonized service delivery. The two organizations are currently working through a joint taskforce at federal and sub-federal levels.

The above data shows that there is strong interest and push from the government side to harmonize service delivery of the two programs. Despite the challenges so far, making the two systems interoperable, if not integration remain to be the government priority.

Table 6: theme 1: perspectives on harmonization of PSNP MIS and CATS

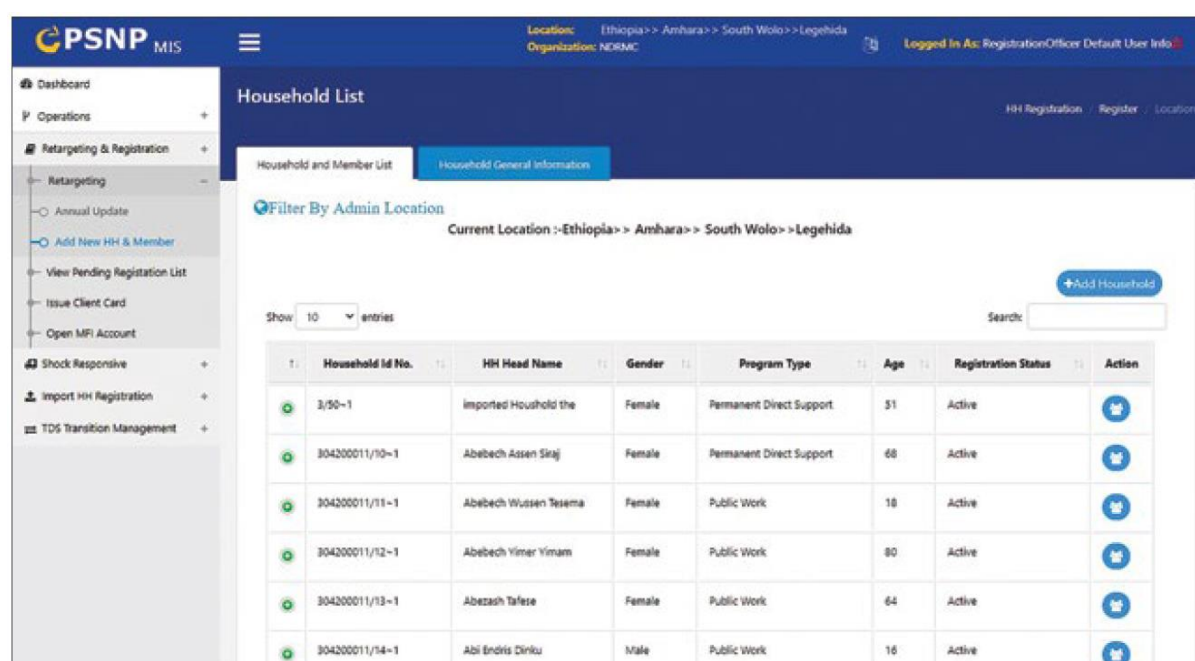
Transcribed data extracted from the in-depth interview	Codes (subthemes) extracted from the transcribed data	Main Theme
The HFA was once under MOA with food security. This was an ideal structure for me. But, now they are under two different organizations. That is why harmonization of the two programs has become the prime agenda and too difficult to achieve too.	Program harmonization	Perspectives on harmonization of the PSNP-MIS and CATS,
	Independent organizations	
	Integrated MIS	
Efforts have been made to instrumentalize an integrated MIS for the different social protection as of 2016. However, the envisioned system has never been materialized. So, each individual Social Protection program implementing organizations were advised to strengthen their respective MISs and then to collaboratively work towards one integrated system.	Organization focused MIS	
	Common understanding	
	Data sharing	
	Competition for resource	
Due to the failure to realize an integrated MIS for social protection programs, the two organizations (MOA and EDRMC) turned their focus to align their data management systems. This was because linking MISs of the two largest programs would be costly and there is already an common understanding between the two organizations.	Donor's demand	
	Harmonized service delivery	
It has practically been a huge challenge for the reason that the two organizations are independent and autonomous. The competition for resources channelled by different donors is also what drives the government to tie the two organizations under harmonized service delivery. The two organizations are currently working through a joint taskforce at federal and sub-federal levels.	Joint task force for DRM	

Theme 2: Design and functionality of the two systems

The researcher tried to understand the design and the current functionality of the two systems. According to secondary sources, the PSNP MIS, also called ‘Social Protection Management Information System (SPMIS)’ is the MIS developed for data management of the program to replace the PASS and RPASS, software which were used before. According to one informant the SPMIS was developed by consultants and has come long way to become functional.

As was also observed by the researcher, the PSNP MIS was developed by using MYSQL (back end), and DotNet, PHP, Java and other programming languages (front end). It is web-based system accessible both online and offline. The system relies on the Woreda.Net service for woredas to access the system. Though internet connectivity is still patchy in many of the woredas, it works offline and then synchronize the data when internet is available.

Figure 10: PSNP-MIS User Interface



The screenshot shows the PSNP MIS user interface. The top navigation bar includes the PSNP MIS logo, a menu icon, and location information: Ethiopia > Amhara > South Wolo > Legehida. The user is logged in as 'Registration Officer Default User Info'. The sidebar menu on the left lists various functions: Dashboard, Operations, Retargeting & Registration (with sub-options like Annual Update, Add New HH & Member, View Pending Registration List, Issue Client Card, Open MFI Account), Shock Responsive, Import HH Registration, and TDS Transition Management. The main content area is titled 'Household List' and shows a table of households. The table has columns for Household Id No., HH Head Name, Gender, Program Type, Age, Registration Status, and Action. The current location is set to Ethiopia > Amhara > South Wolo > Legehida. There is a search bar and a '+Add Household' button.

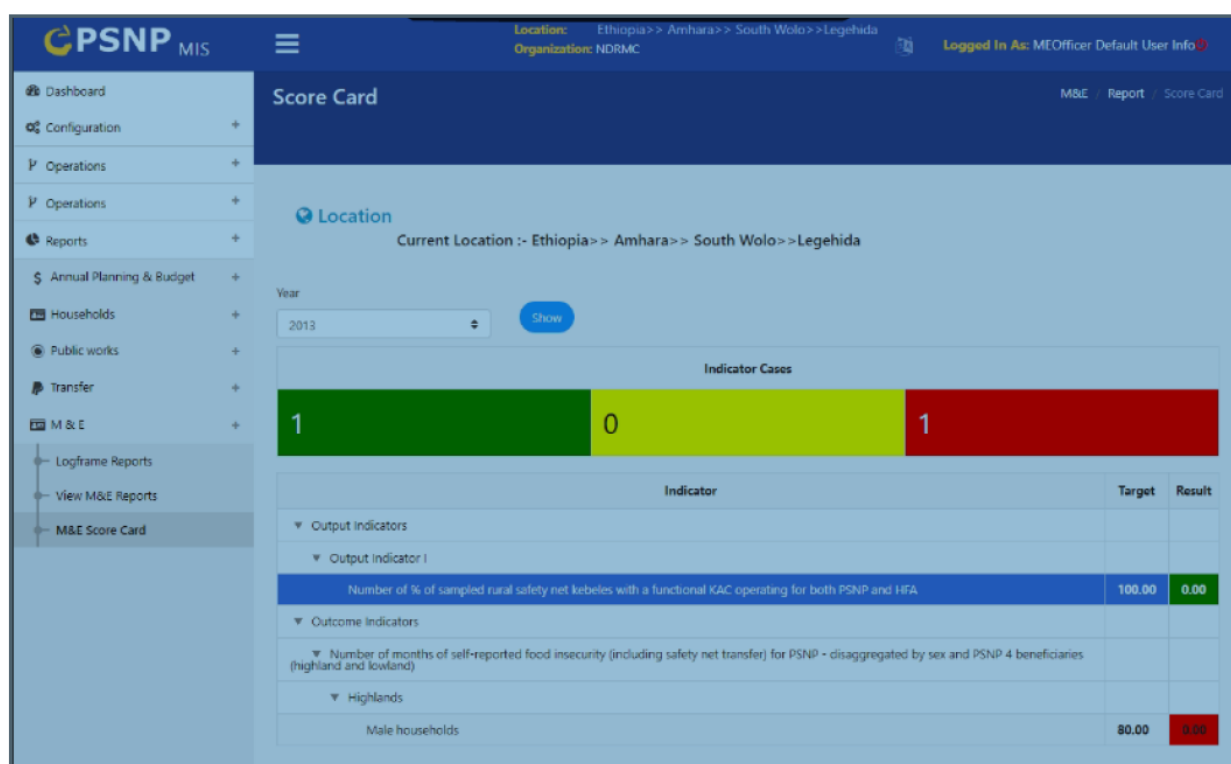
Household Id No.	HH Head Name	Gender	Program Type	Age	Registration Status	Action
3/50~1	Imported Household the	Female	Permanent Direct Support	51	Active	
304200011/10~1	Abebech Assen Siraj	Female	Permanent Direct Support	68	Active	
304200011/11~1	Abebech Wossen Tesema	Female	Public Work	18	Active	
304200011/12~1	Abebech Yimer Yimam	Female	Public Work	80	Active	
304200011/13~1	Abezash Tafese	Female	Public Work	64	Active	
304200011/14~1	Abi Endris Dinku	Male	Public Work	16	Active	

According to the user manual, the MIS has seven major functions. These are: Targeting and Registration, Public work, TDS Transition Management, PDS Management, Compliant Management, Livelihood Management, and Transfer. It has also shock responsive element which records the additional support given to PSNP beneficiaries in time of drought. (PSNP-MIS)

More specifically, the SPMIS is expected keep data about the program beneficiaries and transactional data about the program service delivery. The Registry was set to include both

household-level (e.g. geographical location, contact information, PSNP Component, etc.) and individual household member-level (e.g. age, gender, disability, etc.) data. The MIS was also set to serve different modules: Targeting (Entry, Updates & Exit), temporary Direct Support (TDS) Status Management, public work (PW Attendance), Livelihoods, Shock-responsive Scalable Safety Net, and payment and Reconciliation [17]

Figure 11: : PSNP-MIS User Interface on Reporting



As mentioned in the previous section, the PSNP-MIS was supposed to be in place in 2016, i.e. as of the fourth phase of the program (2016-2020). However, informants agreed that the system development has not been materialized as planned. The MIS is not still fully functional either. According to interviewees, the development of first phase of the MIS is completed and installed at Ministry of Agriculture data center for pilot exercise. Offline and online functionality/application development was also completed and data migration was on progress in 2022 EC. In addition, to enable the MIS tracks beneficiaries, the Ministry has commissioned different firms to collect beneficiary profiles through field survey. [10].

Currently, the MIS is under the enhancement phase, integrating the different modules and services of the program such as enrolment, targeting, payment, transfer and grievance handling. In relation to this, the identification of additional requirements for updating the development

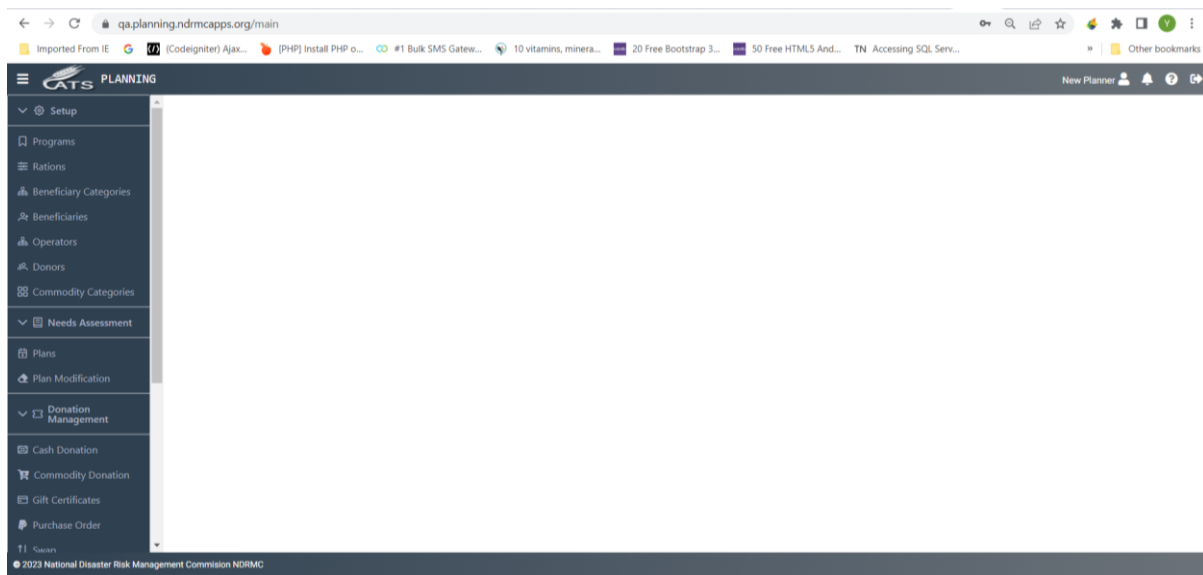
of Public Works Map Database System has been completed. In addition, the Ministry plans to integrate the MIS with Commercial Bank of Ethiopia (CBE) for payment Transfer [10]

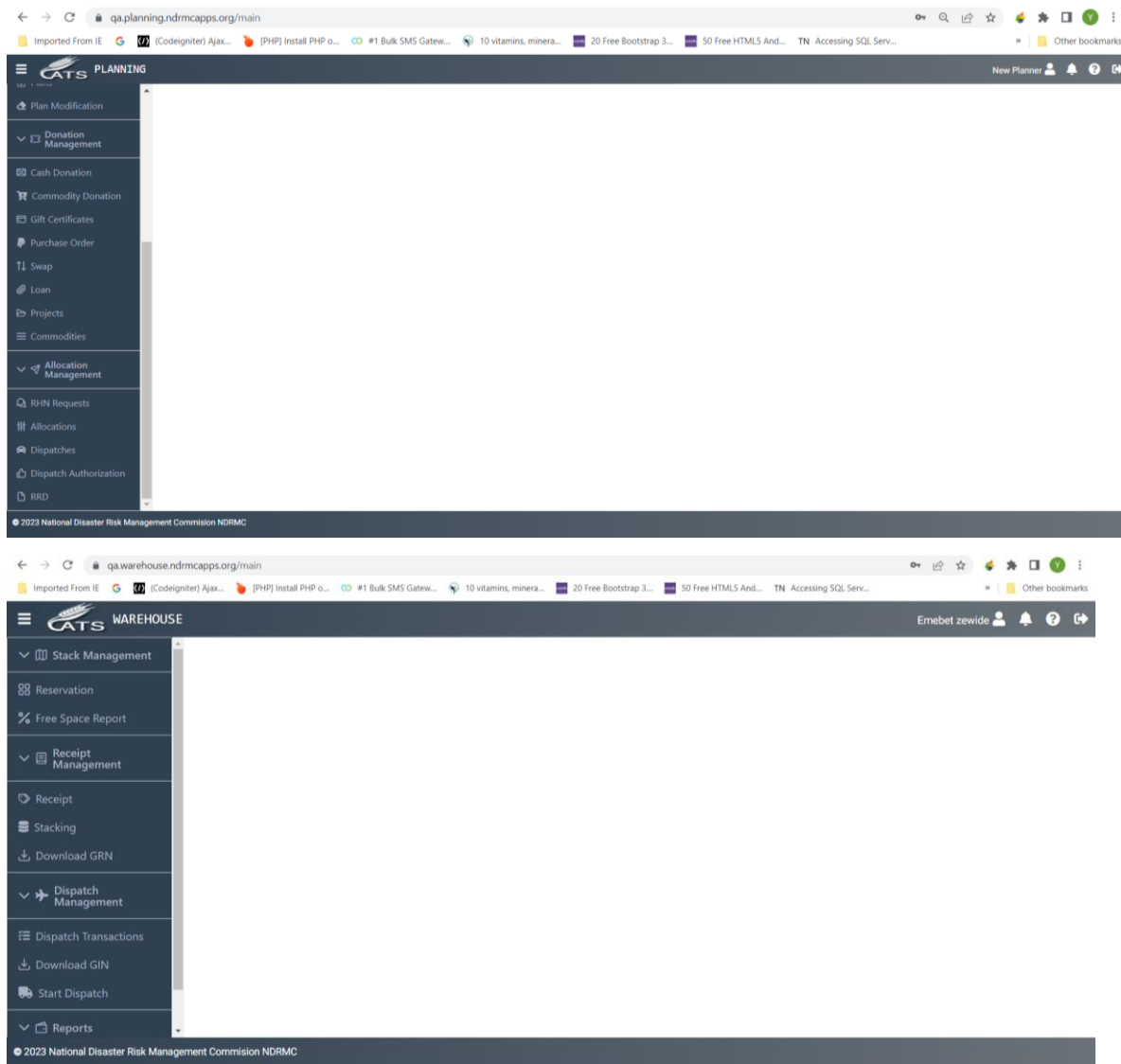
On the other hand, Commodity and Allocation Tracking System (CATS) is a software for tracking commodity movements managed through NDRMC (National Disaster Risk Management Commission) humanitarian supply chain. CATS is an initiative by NDRMC and is part of FMIP (Food Management Improvement Project) designed to link the different parts of the Disaster Risk Management & Food Security Sector (DRMFSS) supply chain so that commodities received from a particular donor can be tracked all the way to the beneficiary.

The aim of the CATS project is to improve the visibility of commodities as they move from the donor to the beneficiaries, through the DRMFSS supply chain, leading to improved reporting to the donors.

According to informants, CATS is developed by teams of consultants since 2010. The observation revealed that it is developed by using mainly C+ and Javascript programming languages. CSS, HTML, classic ASP and SQL were also used to a limited extent. CATS was designed in a way it is accessed at federal, regional and warehouse level.

Figure 12: User Interface of CATS and the different modules





Like the PSNP-MIS, CATS has also problem in terms of full functionality. According to one informant,

CATS was thought of since 2010. However, its functionality is still problematic. Piloting of the system is recently started. But, for the time being, it is mainly working to track food distribution taken out of the commission's warehouses. Though the Commission has a plan to track the food distribution down to beneficiary level, this is by far at early phase.

As also witnessed by informants, despite huge pressure from donors to fully in place the system, CATS is still said to be partially functional, or have on and off functionality.

Table 7: Theme 2-Design and functionality of the two systems

Transcribed data extracted from the in-depth interview	Codes (subthemes) extracted from the transcribed data	Main Theme
CATS is developed by teams of consultants since 2010. The observation revealed that it is developed by using mainly C+ and Javascript programming languages. CSS, HTML, classic ASPO and SQL were also used to a limited extent. CATS was designed in a way it is accessed at federal, regional and warehouse level	Consultant made Mix of PLs Problematic functionality Food distribution tracking Warehouse management Donor pressure	Design and functionality of the two systems
CATS was thought of since 2010. However, its functionality is still problematic. Piloting of the system is recently started. But, for the time being, it is mainly working to track food distribution taken out of the commission's warehouses. Though the Commission has a plan to track the food distribution down to beneficiary level, this is by far at early phase.		
Despite huge pressure from donors to fully in place the system, CATS is still said to be partially functional, or have on and off functionality.		

Theme 3: Information requirements of the two MISs

Informants were asked to mention the data and information needs of their respective programs. Informants from PSNP side made it clear that the program has clear set of performance indicators for which data is generated.

According to an MIS expert,

The PSNP-MIS is mainly set to serve reporting purposes among others. Hence, the type of data being collected by the program relate to the agreed indicators agreed in the program document. The indicators are both output and outcome indicators.

Asserting this, another program expert said

Everyone knows what kind of data and information is useful for the program. The problem is in generating it timely and with quality

According to secondary data, the following is the list of indicators currently being used/demanded by PSNP.

Table 8: List of indicators used by PSNP.

Program	Reporting Indicators
Registration	• Number of registered applicants disaggregated by sex and age • Number of registered applicants disaggregated by socio-economic status
Targeting/Enrolment	• Number of potential targeted beneficiaries • Number of actual targeted beneficiaries • Number of applicants rejected as a result of appeals or any other reason approved by the program • Number of applicants included • Number of potential beneficiaries that did not enrol and reasons why not
Payments	• Number of beneficiaries to be paid after enrolment • Benefit size/Level • Number beneficiaries who received the payments in timely manner • Number of beneficiaries aggregated by payment cycle
Graduation/Exit	• Number of beneficiaries graduating/exiting from the program • Number of beneficiaries graduating/exiting from the programming according to the criteria
Financing/contribution/ Expenditure	• Amount of government/employee/beneficiary's/ Employers contribution • Amount of donor's contribution • Amount of others contribution • Amount of Expenditure disaggregating by benefit/administrative
Grievance handling/ Complaints	• Number of complaints submitted disaggregated by age and sex and social-economic • Number of complaints resolved • Number of Beneficiaries included/add as a result of appeals or any other reason approved by the program • Number of Beneficiaries removed as a result of appeals or any other reason approved by the program
Case Management/Linkage to Basic Services	• Types and number of Services available • Number of beneficiaries comply to the co-responsibility disaggregated by Co-responsibility • Type of reason for non-complaints

As can be referred from the above list, the PSNP-MIS system collects data that would be fed into the above reportable indicators. These take two types of data: beneficiary registry data and

transaction data. As part of the beneficiary registry, the system collects the following data type and attributes

Table 9: Type of Information and key attributes of PSNP

Type of Information	Variable	Attributes
Household profile	Name of HH head	String
	Geographical location,	Region, zone, woreda
	contact information	Kebele, got
	PSNP Component	TDS, PDS, livelihood, SRSN, etc
Individual profile (household member data)	Age	Numeric
	Gender,	M/S
	Disability	Yes/ No

As part of transaction data, the data collected by the system has also various attributes, and these are linked with the services being provided to the beneficiaries.

Coming to CATS, it is mainly a commodity focused MIS, but its initiative is to track the commodity disbursement until beneficiary level. With this in mind, HFA is mainly measured in terms of inclusiveness, flexibility, timeliness, efficiency, accountability and risk management aspects of the humanitarian support.

According to the Humanitarian Food Assistance operational manual and its Common performance framework, the following specific indicators are used by HFA program:

- Amount of food and other commodity planned
- Amount of food and other commodity secured from donors
- Amount of food and other commodity allocated
- Amount of food and other commodity distributed to
- Number of woredas benefited from the support
- Number of households receiving the support
- Number of population affected by disasters

In order to measure the above indicators the system collects more specific data with varied attribute in each case.

Table 10: Theme 3: Information requirements of the two MISs

Transcribed data extracted from the in-depth interview	Codes (subthemes) extracted from the transcribed data	Main Theme
The PSNP-MIS is mainly set to serve reporting purposes among others. Hence, the type of data being collected by the program relate to the agreed indicators agreed in the program document. The indicators are both output and outcome indicators.	Reporting purposed Outcome and output indicators Performance based data Timely and quality data	Information requirements of the two MISs
Everyone knows what kind of data and information is useful for the program. The problem is in generating it timely and with quality		

Theme 4: The data management practice for the two MIS

Under this theme, the researcher tried to understand, three sub-themes: the data collection and source of data, data analysis and reporting as well as responsibility in data management.

Responses on the source of data showed that data for the two systems come through different sources. For the PSNP, data comes through service provision, annual beneficiary data entry/update and beneficiary household data. The data comes mainly from woreda level experts during service provision. As one source put it

The routine data of PSNP come from service register. Whenever, there is food provision or cash transfer, the woreda experts recorded the service on hard copy and then enters it into the system.

It is almost the same for CATS too. According to one respondent

The data for CATS comes through storekeepers working at warehouse level. This focuses on the amount and type of commodity received and disbursed. Of course, data on list of people receiving the support is taken at food distribution centers, but it is not being entered into the system.

Another respondent added that the routine data is kept on commodity receiving and dispatch vouchers. And commodities received from donors or procured is tracked at all levels.

The other source which is applicable for PSNP only is the household survey. This was aimed at tracking the socio-economic status of target households so as to support the graduation/ exit of beneficiaries. To use the words from one respondent

The PSNP had no complete profile of its beneficiaries and this was the main reason affecting performance tracking process. It has only been started collecting such data. This is being done by commissioned consultants and so far data from 500000 households was collected and entered into the system

In addition, the PSNP allows targeting of new beneficiaries and updates their profile on annual basis. As there would be a change in the status of target households and their members, this type of data is dynamic. The woreda officer is responsible to collect such data and update the MIS.

Like in the case of PSNP, HFA also collects data through seasonal and rapid assessments. This is done mainly during ‘meher and ‘belg’ seasons to see the possibility of drought in the given area and this is used to inform the dashboard and then the DRAP and HRP

In terms of data analysis, the two programs use common data analysis methods, largely by using excel. An informant from PSNP reported

There is generally a problem in having quality data. However, the available data is mainly analyzed on excel. We use quantitative data analysis methods

In terms of reporting, respondents from both programs agree that the data is mainly used to report program performance to donors. According to an informant from MOA,

I doubt there is full ownership of the top leadership of the MIS. The recent progress is largely due to the pressure from the donors as putting in place the MIS was one of the performance indicator affecting release of next budget.

The other question was regarding the responsibility for data management for each programs. According to respondents from PSNP, the data is collected by front line officers who provide the support to beneficiaries and enter the data at woreda level. There are also MIS staff at zonal and regional levels who will check quality of data, analyze and report their respective performance. However, this is not the same for EDRMC. Though the Commission has an MIS unit at federal level, its capacity is limited at lower levels.

According to one respondent from the Commission

In terms of data management, we directly work with regional hubs and 8 warehouses, and it is the store keepers who are primarily responsible to collect the data. This will reach the central data management unit at the commission. However, there are problems with the functionality of the system.

There are several organizations and internal directorates that are involved in implementation of the PSNP. Each assumes some roles in data management, mainly in data collection. However, the FSCO is the lead implementing/ coordinating office within which there is an MIS personal responsible to administer the system. At the same time, there are MIS personnel at zone and woreda levels responsible to collect and decode the data into the system. The summary of the different work units involved in managing data for the two programs looks like the below.

Table 11: the key responsible bodies for data management

Level	MOA	EDRMC
At federal level	FSCO- NRMD Agri-extension Irrigation System Administrator NRMD ATVET	EWS Directorate DRR Directorate Commodity management Directorate Logistics Directorate Procurement Directorate
At regional level	Structures of the above at this level	Structures of the above at this level
At woreda level	Structures of the above at this level	Structures of the above at this level
At kebele/ community level	Kebele PSNP Selection Committee	DRR Committee

The availability of designated unit for MIS works plays a key role for effective use of MIS for the intended purpose. In this regard, both institutions have an MIS unit that oversees the data system. In the case of MOA, there is an MIS Directorate at Ministry level and there is an MIS professional for the PSNP.

On the other hand, the commodity and logistics team are the ones responsible to lead the commodity business and the ICT team being responsible for the technical aspects of the system. The system works mainly through the supply chain and the storekeepers are primarily responsible to keep the data on the commodity requested, reserved, requested and distributed

In general, PSNP-MIS seems to have better staff for data collection, analysis and reporting. However, CATS is still struggling to go fully functional.

Table 12: Theme 4: The data management practice for the two MIS

Transcribed data extracted from the in-depth interview	Codes (subthemes) extracted from the transcribed data	Main Theme
The routine data of PSNP come from service register. Whenever, there is food provision or cash transfer, the woreda experts recorded the service on hard copy and then enters it into the system.	Service register Food provision Cash transfer	The data management practice for the two MIS
The data for CATS comes through storekeepers working at warehouse level. This focuses on the amount and type of commodity received and disbursed. Of course, data on list of people receiving the support is taken at food distribution centers, but it is not being entered into the system.	Hard and soft copy amount and type of commodity receiving and disbursement of aid	
The PSNP had no complete profile of its beneficiaries and this was the main reason affecting performance tracking process. It has only been started collecting such data. This is being done by commissioned consultants and so far data from 500000 households was collected and entered into the system	food distribution center beneficiary profile performance tracking process	
There is generally a problem in having quality data. However, the available data is mainly analyzed on excel. We use quantitative data analysis methods	Quality of data Household survey	
I doubt there is full ownership of the top leadership of the MIS. The recent progress is largely due to the pressure from the donors as putting in place the MIS was one of the performance indicator affecting release of next budget.	Annual tracking Beneficiary update	
In terms of data management, we directly work with regional hubs and 8 warehouses, and it is the store keepers who are primarily responsible to collect the data. This will reach the central data management unit at the commission. However, there are problems with the functionality of the system.	Central data management Functionality problem	

Theme 5: Collaborative Businesses of the two programs

One of the key feature of AIOS is its delineation of information in to private, public and global. Respondents were thus asked to forward the type of information that they think should be privately kept, jointly managed by both organizations and those that cab be made available for other social protection programs beyond PSNP and HFA.

Responding to this, the easiest demarcation made by respondents was based on the components of PSNP. According to one respondent

Shock Responsive Safety Net (SRSN) is one component of PSNP which MOA and EDRMC are both implementing in different woredas. So, as this is their joint interest area, all data pertaining to SRSN should be jointly managed by the two organizations. All data related to other components of the PSNP program should be privately managed, where as profile of beneficiaries of each program should be globally viewed as this is also the concern of other social service providers

Corroborating to this another respondent said that

SRSN is in the intersection of PSNP and HFA programs. Hence, the SRSN module of the PSNP-MIS should be publicly [jointly] managed by the two organization. This means that profile of beneficiaries of this component and the type of supported provided to them should be the common data that both programs are interested in.

One other informant had also the below to say:

What the two programs [PSNP and HFA] shared is the commodity management aspect of SRSN and this is largely food provision or cash transfer. So, if the two organizations jointly manage commodity management and payment service, there could be good interoperability of the two MISs.

On the other hand, some respondents went a bit further to make a more detailed demarcation. According to one informant, for example reported

Enrolment, registration and the temporary support which will take either food or cash form are the collaborative businesses of the two programs. For me, except the permanent direct support and the grievance handling mechanism, all the others are required for both programs. Thus, I prefer function based demarcation that component based

Closely resembling the above response was the one forwarded by another informant. According to this source

The two programs follow similar processes as of the enrolment stage, though their selection criteria is different.. The basic difference between the two is PSNP focuses on permanent support while HFA is temporary. In relation to the purpose of PSNP, the program provides long-term supports including livelihood support and has also graduation which is not the case for HFA. Thus, this could be a basis for demarcating the private and common businesses of the two organizations.

Another way of demarcating the information is based on the beneficiary profile. Those who supported this had the view that all data related to PSNP should be managed by PSNP_MIS and all the data of non-PSNP beneficiaries should be jointly managed by both as these are the prime reason why HFA reaches out PSNP target woredas. However, this is against the scope and donor interest

What is evident from the above responses, all things related to Shock Responsive Safety Net is the common interest and focus of both organizations. Thus, it should jointly managed by the two MISs. However, as this component [SRSN] reaches out to PSNP and non-PSNP households in PSNP target woredas, the process from enrolment to exit should be viewed and managed by both programs.

Table 13: Theme 5: Collaborative Businesses of the two programs

Transcribed data extracted from the in-depth interview	Codes (subthemes) extracted from the transcribed data	Main Theme
Shock Responsive Safety Net (SRSN) is one component of PSNP which MOA and EDRMC are both implementing in different woredas. So, as this is their joint interest area, all data pertaining to SRSN should be jointly managed by the two organizations. All data related to other components of the PSNP program should be privately managed, where as profile of beneficiaries of each program should be globally viewed as this is also the concern of other social service providers	Shock responsive Safety net PSNP program components Profile of beneficiaries Type of support	Collaborative Businesses of the two programs

SRSN is in the intersection of PSNP and HFA programs. Hence, the SRSN module of the PSNP-MIS should be publicly [jointly] managed by the two organization. This means that profile of beneficiaries of this component and the type of supported provided to them should be the common data that both programs are interested in.	<i>Commodity management</i> <i>Payment service</i> <i>Food and cash transfer</i> <i>Function based demarcation</i> <i>Enrolment</i> <i>Registration</i> <i>Selection criteria</i> <i>Permanent support</i> <i>Temporary support</i> <i>Graduation</i>	
What the two programs [PSNP and HFA] shared is the commodity management aspect of SRSN and this is largely food provision or cash transfer. So, if the two organizations jointly manage commodity management and payment service, there could be good interoperability of the two MISs.		
Enrolment, registration and the temporary support which will take either food or cash form are the collaborative businesses of the two programs. For me, except the permanent direct support and the grievance handling mechanism, all the others are required for both programs. Thus, I prefer function based demarcation that component based		
The two programs follow similar processes as of the enrolment stage, though their selection criteria is different.. The basic difference between the two is PSNP focuses on permanent support while HFA is temporary. In relation to the purpose of PSNP, the program provides long-term supports including livelihood support and has also graduation which is not the case for HFA. Thus, this could be a basis for demarcating the private and common businesses of the two organizations.		

Interviewees were also asked to name the different parties involved in the implementation of the two programs. According to sources, there are numerous actors within the organizations and beyond. This depends on the kind of activities that beneficiaries are expected to be engaged and the work unit responsible to lead that technical activity in each organization will take part in the implementation of the respective programs.

Theme 6: Technical operability of their MISs

Respondents were requested to describe the technical aspects of the two systems. According to sources at PSNP, the PSNP-MIS has relatively good IT infrastructure at head office level. As one source put it:

The Coordination Office has a huge server that is compatible with the data storage requirements of the system. The MIS staff at federal and regional level has also enough computers with the required communication facilities. However, this gets thinner when one goes down to woreda level.

The key challenge in terms of technical aspect is the poor telecom infrastructure at woreda level. According to sources,

We use the governments woreda net system for communication. However, this doesn't always work. For that reason, we have made the system work both online and offline.

Coming to CATS, it is a cloud based database system that is functional at federal and regional hubs. Relatively speaking, CATS modules are categorized based on the business processes of the organizations. It is not managed by one work units, but by different work units. It mainly focus on tracking commodity distributed to warehouses and beneficiaries.

The above data shows that the two systems have quite good technological facilities to at least start towards interlinking their system. However, given the different capacities they have, more facilities may need to be fulfilled especially for CATS.

Table 14: Theme 6: Technical operability of their MISs

Transcribed data extracted from the in-depth interview	Codes (subthemes) extracted from the transcribed data	Main Theme
The Coordination Office has a huge server that is compatible with the data storage requirements of the system. The MIS staff at federal and regional level has also enough computers with the required communication facilities. However, this gets thinner when one goes down to woreda level.	Huge server Data storage requirements Computers Communication facilities	Technical operability of their MISs
We use the governments woreda net system for communication. However, this doesn't always work. For that reason, we have made the system work both online and offline.	Woreda Net system Online and off line functionality	

Theme 7: Issues on Data Sharing and Interoperability

Informants were asked to list out concerns and challenges in terms integrating the different social protection MISs in general, and specifically in terms of data sharing between PSNP-MIS and CATS. Responding to this, informants had long list of challenges to forward. What almost all informants agreed was that the independence of the two institutions and their different structures at regional and sub-regional levels has been the main challenge.

According to one of the respondents, for example,

Though the two programs had much to share in common, there is little coordination between the two different organizations leading the programs, affecting data sharing between them. The fact that coordination platforms are largely adhoc and the varied reporting needs of donors also hamper data sharing and interoperability between the two programs.

Another informant reminded the historical background when the DRM sub-sector was once under MOA. According to this informant, this had enabled the government run both PSNP and HFA programs under same institution, avoiding duplication of efforts and more harmonized service delivery for the people in need.

The different structure and capacity of the two institutions at regional and sub-regional levels was also mentioned among the challenges. According to one source,

In some regions DRM and PSNP are implemented under same organization and this helped to smoothen data sharing among the two programs. However, in cases where the two programs are run by different entities, data sharing has been more challenging. This has become more serious as one goes down to woreda level, according to interviewees.

In relation to this, documentary sources have that MOA and EDRMC has varied capacity going down to lower administration levels. In this regard, MOA has relatively better presence at woreda levels, while EDRMC is just a unit under woreda administration in some cases, further affecting communication and coordination between the two programs.

The technical expertise on data management is the other critical challenge for data sharing and interoperability between the two systems. To use their own words,

“There was no adequately trained data management professionals in both institutions, especially at sub-national levels. Those available at federal levels are also all recruited

by donors affecting sustainability of the MIS work too. For that reason, we have always job insecurity because the government cannot pay our salary and are only paid when donors are willing to do so.

The other major operational challenge is the unreliable telecommunication infrastructure which goes more serious going down to woreda levels. According to one source,

Poor infrastructure is particularly more challenging in rural woredas including pastoral ones. In this regard, though the PSNP-MIS supports offline functionality, it is usually an issue to timely sync the woreda data to regions and central servers.

All informants agree on the above problems. , shortage of budget, the high number of woredas and population that need humanitarian assistance were also mentioned,

For some informants, absence of previous household profile was a challenge to track program beneficiaries and produce reliable outcome data. In relation to this, absence of a national Id system is one of the challenges, causing duplication of beneficiaries in some cases. According to the professionals leading the PSNP-MIS roll-out, they have now started working closely with the National Digital ID service to link the PSNP household profile to the system. This is taken as a great opportunity to materialize the interoperability by many of the informants.

Informants didn't go without mentioning the gaps in policy and legal framework too. Apart from this, informants brought the fact that the functionality of PSNP-MIS was put as one of performance based costs for the program, which increases the leadership commitment in making it happen and also is progressed well. However, some others still question the ownership and commitment of the government in realizing the full functionality and interoperability of the two MISs.

Table 15: Theme 7: Issues on Data Sharing and Interoperability

Transcribed data extracted from the in-depth interview	Codes (subthemes) extracted from the transcribed data	Main Theme
There is little coordination between the two different organizations leading the programs, affecting data sharing between them. The fact that coordination platforms are largely adhoc and the varied reporting needs of donors also hamper data	Coordination Data sharing	Issues on Data Sharing and Interoperability

sharing and interoperability between the two programs.	Adhoc coordination platforms	
In some regions DRM and PSNP are implemented under same organization and this helped to smoothen data sharing among the two programs. However, in cases where the two programs are run by different entities, data sharing has been more challenging. This has become more serious as one goes down to woreda level, according to interviewees.	Interoperability Implementing organizations Woreda level capacity Data management professionals	
There was no adequately trained data management professionals in both institutions, especially at sub-national levels. Those available at federal levels are also all recruited by donors affecting sustainability of the MIS work too. For that reason, we have always job insecurity because the government cannot pay our salary and are only paid when donors are willing to do so.	Sustainability of MIS Job insecurity IT infrastructure Off-line functionality	
Poor infrastructure is particularly more challenging in rural woredas including pastoral ones. In this regard, though the PSNP-MIS supports offline functionality, it is usually an issue to timely sync the woreda data to regions and central servers.		

4.3. Discussion

In this section, the findings of the research are discussed in relation to the research questions, and specific research objectives. The findings from the in-depth interview, observation, and document analysis are also triangulated under the themes identified in the analysis section.

Theme 1: Perspectives on harmonization of the PSNP-MIS and CATS

This was part of the assessment made to understand the policy and practice of information management under the two programs. According to primary sources, harmonizing the two programs is currently the priority of the government and a task force is formed and is working on to make it happen. This was also supported by the national social protection policy which clearly articulated the need for harmonizing the two programs. Several periodical and evaluation reports also underlined the same fact.

By the same token, the two institutions are working to strengthen their respective data management system. What all respondents agreed was the need for interlinking the two MISs for efficient and effective management of the SRSN, which is the common interest of both programs.

Theme 2: Design and functionality of the two systems

As part of the assessment, the researcher investigated the status of the design and functionality of the two systems. Accordingly, it was found out that the two systems were developed by using different mix of programming languages, and the design of the systems took years to happen. Though there are quite good progress in recent years, there is still gap in functionality of the systems.

Relatively speaking the PSNP-MIS has better functionality in that it has made at least some of its modules fully functionals and the team is working to integrate the other modules on phase by phase level. On the other hand, the CATS is struggling to go fully functional

Theme 3: Information requirements of the two MISs

As seen in the previous section, both MISs primarily serve the reporting requirements by donors. For that reason, the type of data integrated into their system was set to generate performance data for the agreed performance indicators of their respective programs. In particular, the modules of the PSNP-MIS was organized on the basis of the different components of the program.

However, the two systems differ in the type of data they manage. For example, the CATS has also elements of resource mobilization, planning and vendor management. Due to this, CATS has somehow purpose broader than program management.

Theme 4: The data management practice for the two MIS

According to informants, source of information for the PSNP comes mainly through beneficiary household survey, annual beneficiary data entry/ update and service provision. As a result, data is collected on routine (When support is given), quarterly, annual and through surveys. The program relies on MS office to analyze the data and output is mainly used for performance reporting. The Program Implementation Manual sets out who will do what. The user manual of the program also describes who will collect, enter and report data, and how frequently.

On the other hand, the CATS collect data through rapid/ seasonal assessment, commodity receiving and dispatch vouchers, and support register. Like in the case of PSNP-MIS, data for the CATS is set to be collected on routine basis and annually. The assessment findings are analyzed and reported in the form of dashboard. Observation made into the system showed, no quality report can be produced from the system.

In terms of the data collection procedure, the data is collected by the PSNP team at kebele level and then sent to woreda team. The woreda team is the one to enter the data into the system. Then this data is consolidated at zonal and next at regional level. Once the data is synchronized, the national MIS team is responsible to aggregate and produce report from the system. The data is first collected on paper form and is then entered into the system. Though there was once an effort to use smart tablet, it hasn't gone well as planned.

The difference between PSNP-MIS and CATS was that MOA collects data including at kebele level, whereas CATS receives data from warehouses, meaning the actual distribution of the commodity to beneficiaries is not currently being tracked. In addition, PSNP-MIS has an intention of tracking the status of target households on regular basis, while CATS focus on the commodity aspect.

According to both primary data and observation, the PSNP team uses the PSNP-MIS manual which is detailed and guide the data entry and management process. One of the key feature of the MIS is user's right to configure the data entry and reports. This helps them produce attendance and payment sheet for participants as observed by the researcher.

Theme 5: Collaborative Businesses of the two programs

Under this theme, the researcher saw two aspects: business functions and business process. Business function refers to the general purpose that is served by an enterprise which consists of tightly related activities. Whereas, business process refers to the steps and procedures followed in an enterprise which is a collection of loosely related tasks. In terms of this, the following processes are stages that the support for beneficiaries in the two programs:

As discussed in the previous sections, the general functions of PSNP-MIS is to manage program implementation from entry to exit of target households. According to informants and observation into the system, the MIS has passes through the following major functions. The analysis from different sources gave us the below process diagram for each program.

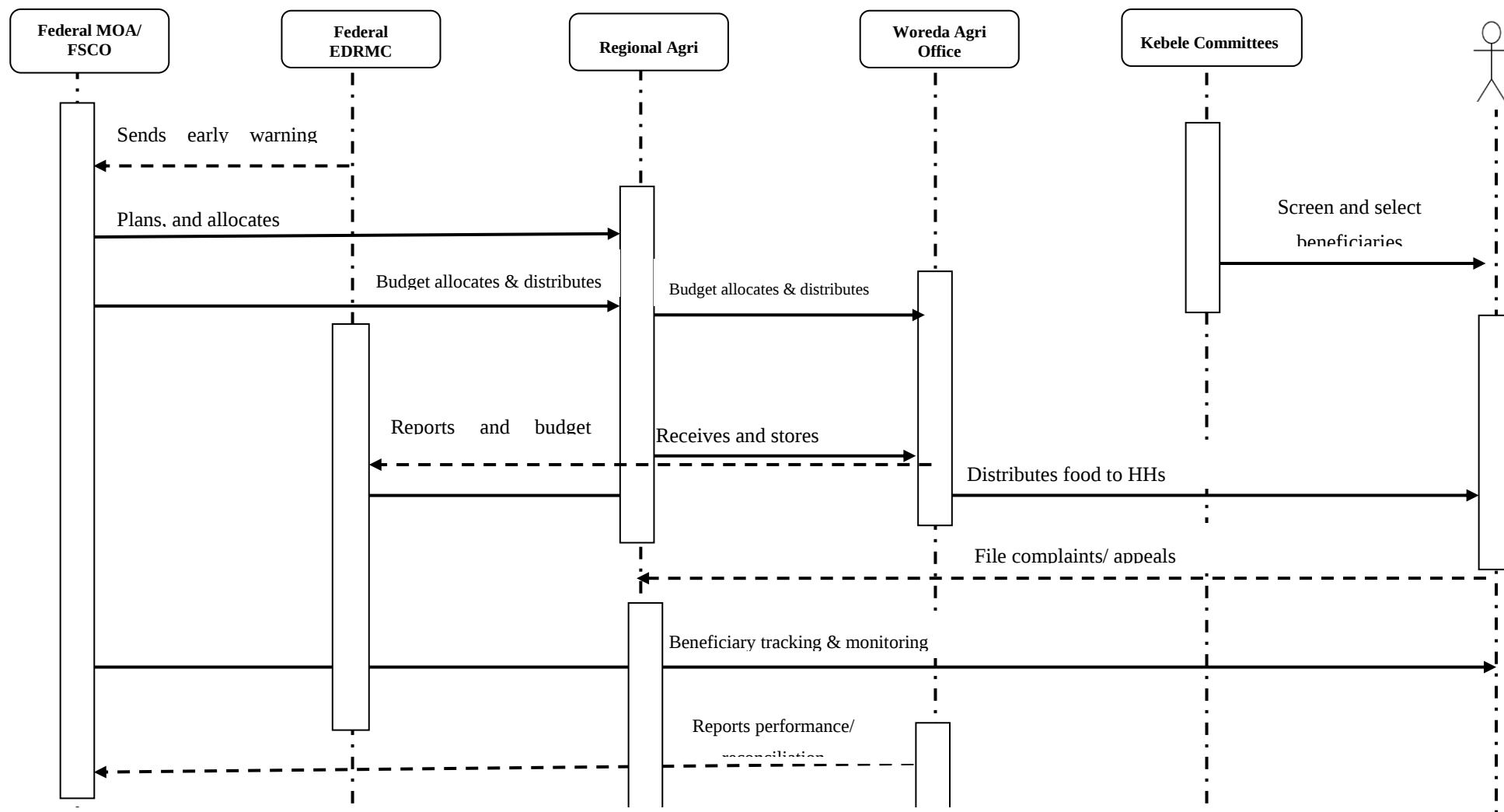


Figure 13: Sequence diagram of key functions of PSNP

On the other hand, the general function in HFA is the allocation and tracking of commodities all the way from the donors to beneficiaries. The MIS has the following specific functions, according to informants and observation into the system:

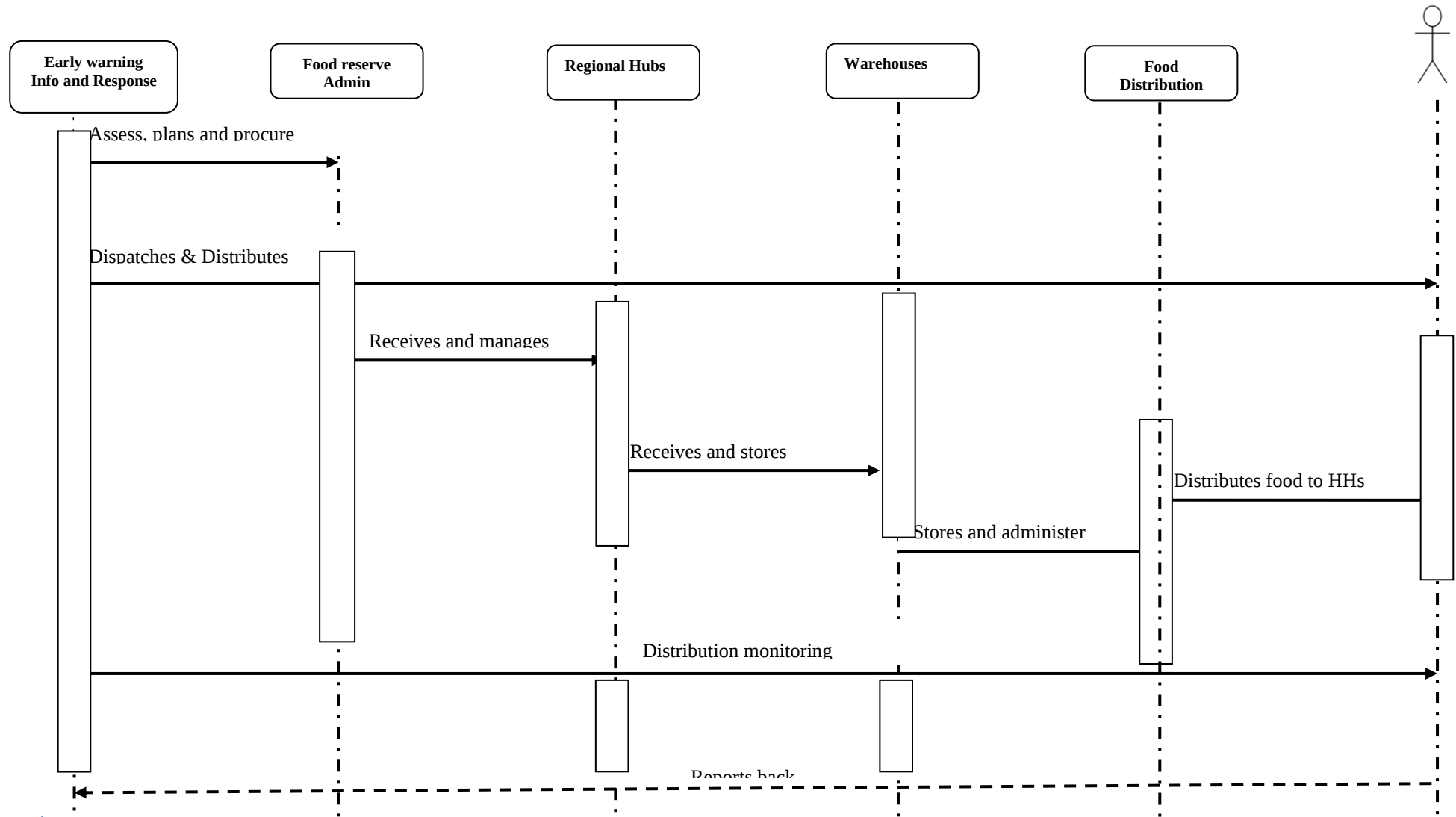
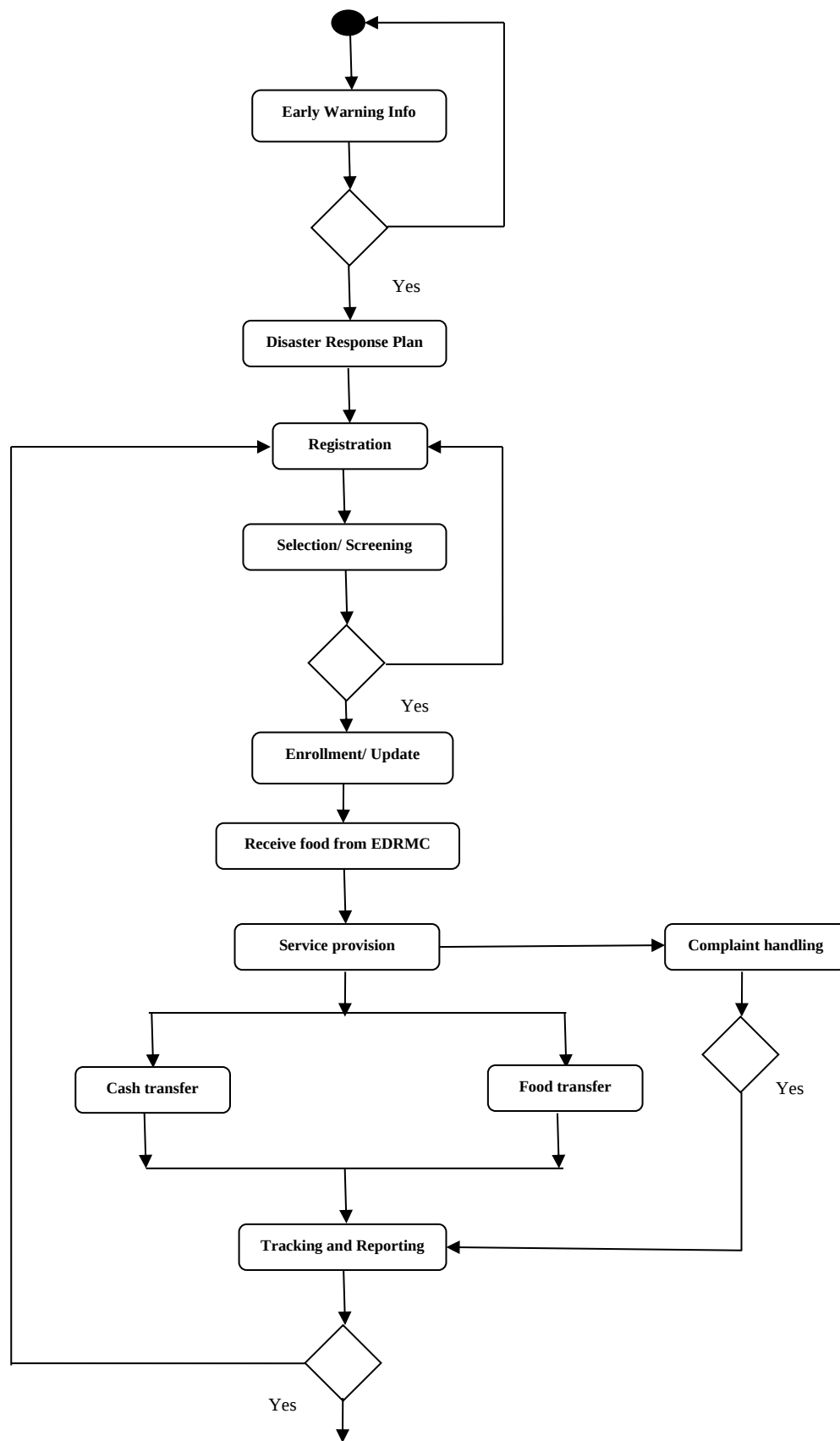


Figure 14: Sequence Diagram of the key functions in HFA

Turning to the business processes of the PSNP, its implementation process starts with intaking of beneficiaries and end up with their exit. However, there are several processes on the course of implementation. Broadly, these processes can be categorized into registration and update, enrollment, service provision, cash/ food transfer, grievance handling and exit. The following is the activity diagram of PSNP as illustrated on informants accounts.



Coming to the te HFA, the program centers on providing life saving support to people in need. As such, the process starts with assessing the situation and ends up when an emergency is over. As informed by interviewees, the HFA passes through the following key processes as depicted in the below activity diagram:

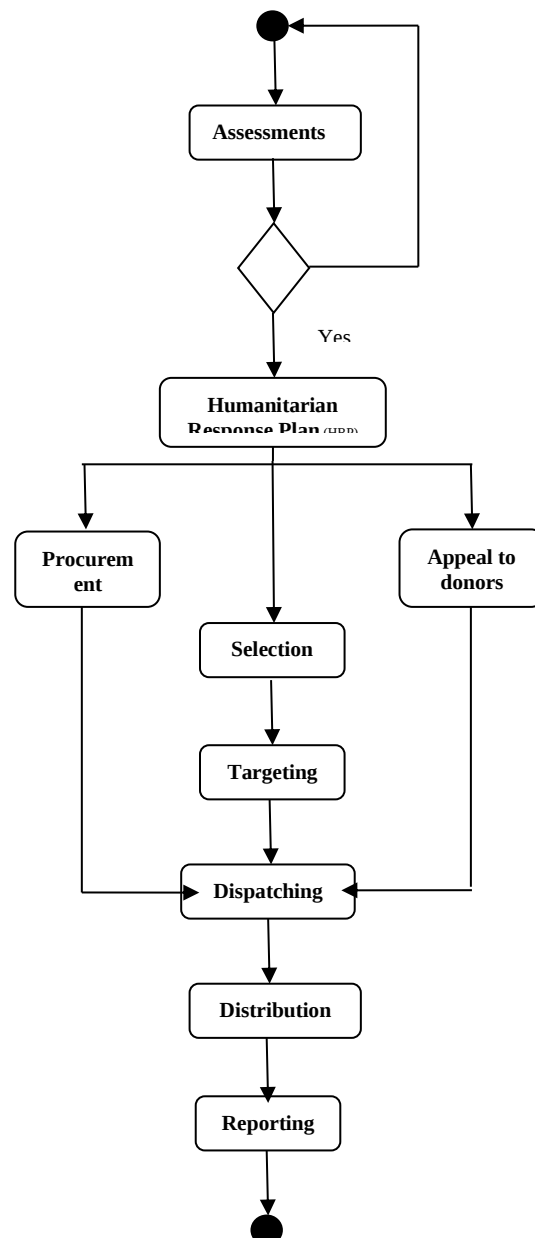


Figure 16: Activity diagram of key processes of HFA program

Theme 6: Technical operability of their MISs

Part of the research question assesses the technical capability of PSNP-MIS and CATS. The first hand information from informants showed that PSNP_MIS has good IT infrastructure and professionals working on the system mainly at federal level. The same holds true for CATS. However, as one gets down to the woreda level, IT infrastructure is poor, availability of computers is limited. Though PSNP starts using mobile based data collection, data analysis and reporting is affected by several factors.

Theme 7: Issues on Data Sharing and Interoperability

Under this theme, we tried to see the various concerns and challenges that the two MISs have to function by themselves and interoperate. In this regard, the primary data showed that structural and institutional factors, i.e. the fact that the two organizations have different structure and capacity at different levels is reported to be the main concern. In relation to this, the availability of qualified staff and IT equipment is added in to the list. Poor IT infrastructure mainly at woreda level has also been one of the major hurdles in data management and sharing.

Of course, the EeGIF provides a good opportunity for the two organizations to progress towards an interoperability SPIS. However, challenges in relation to fulfilling the requirements could rise and these require timely action. Another challenge could be related to property right issue of the consultants working on the system.

In general, there continues to be serious challenges in functioning of the two systems. As a result, interoperability between them can be affected to some extent, though it doesn't prevent it from happening.

4.4. Chapter Summary

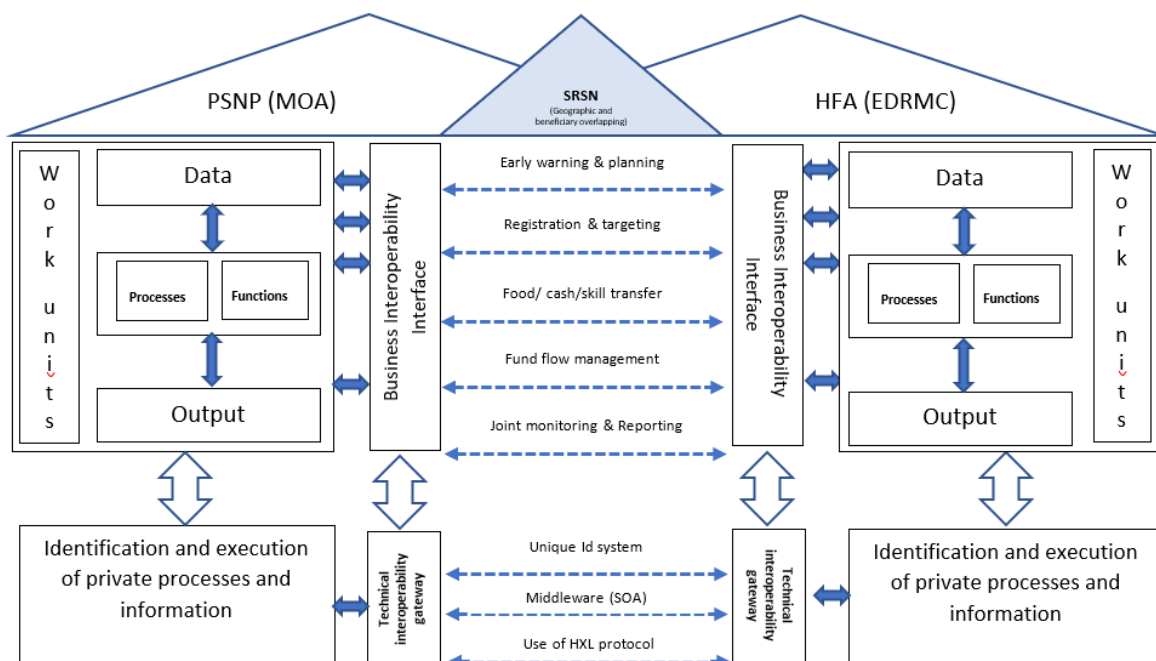
This chapter analyzed the empirical data that was gathered through in-depth interview, observation and document review was presented and analyzed in line with the interoperability framework. The analysis was done through thematic analysis. To ensure integrity of the research findings, data was categorized and seven themes were framed. In addition, discussion was made in line with the research questions and the researcher tried to evidence the status of the two systems, the practice of data management as well as underlying issues for interoperability. The result of this discussion is used to propose an adapted interoperability framework for PSNP-MIS and CATS as will be discussed in the next chapter.

CHAPTER FIVE:

THE PROPOSED ARCHITECTURAL FRAMEWORK

5.1. The Proposed Architectural Framework for Interoperable SPIS

The proposed architectural framework bases Architecture for Interoperable Information System (AIOS) developed by Ziemann. According to him, collaborative business processes and independence of the partnering organizations are at the heart of the architecture. The framework requires to develop an overall structure of how the two independent institutions collaborate each other. In line with this, the following overall structure of the proposed architecture for the envisioned interoperable Social Protection Information System (SPIS) is proposed.



NB: the structure of the two systems as seen at far left and far right seem to be identical. However, the difference is only visible from the description below.

As shown in the above map, the SRSN sub-program is the center of collaboration between PSNP and HFA programs. Simply put, SRSN is a humanitarian food assistance program being implemented by MOA in PSNP woredas. The interoperability between the PSNP and HFA is set to be both in terms of business operation and technical matters. This mainly happens through alignment of their common functions, joint implementation of their key processes and exchange of data on the course of program operation.

As is further detailed in the subsequent sections, early warning information and planning, beneficiary registration and targeting, service delivery (cash/ food/ skill transfer), fund flow management, and joint monitoring and reporting are the key areas for collaborative business processes between PSNP V and HFA . In addition, these two social protection programs are also required to interoperate with other social protection programs.

At the technical interoperability side, the PSNP- MIS and CATS are expected to be linked through middleware so that they can easily communicate one another, and ensure data sharing and reporting beyond their programs. As per AIOS, the interoperability follows Service Oriented Architecture (SOA) and humanitarian data exchange protocol (HDX)² developed by OCHA would be used. This would also be a space where both programs keeps confidential data about their businesses and beneficiaries. The use of unique ID for beneficiaries would be the key factor to ensure interoperability between the two MISs.

According to the AIOS model, after the overall structure of the AIOS is defined, the individual elements comprised of dimensions, i.e. enterprise dimensions: collaborative views and levels of technical granularity, of the architecture should be specified. This needs to be followed by description of each of the three constituting elements: This proposed architectural framework showing the three dimensions of AIOS is presented in the below way.

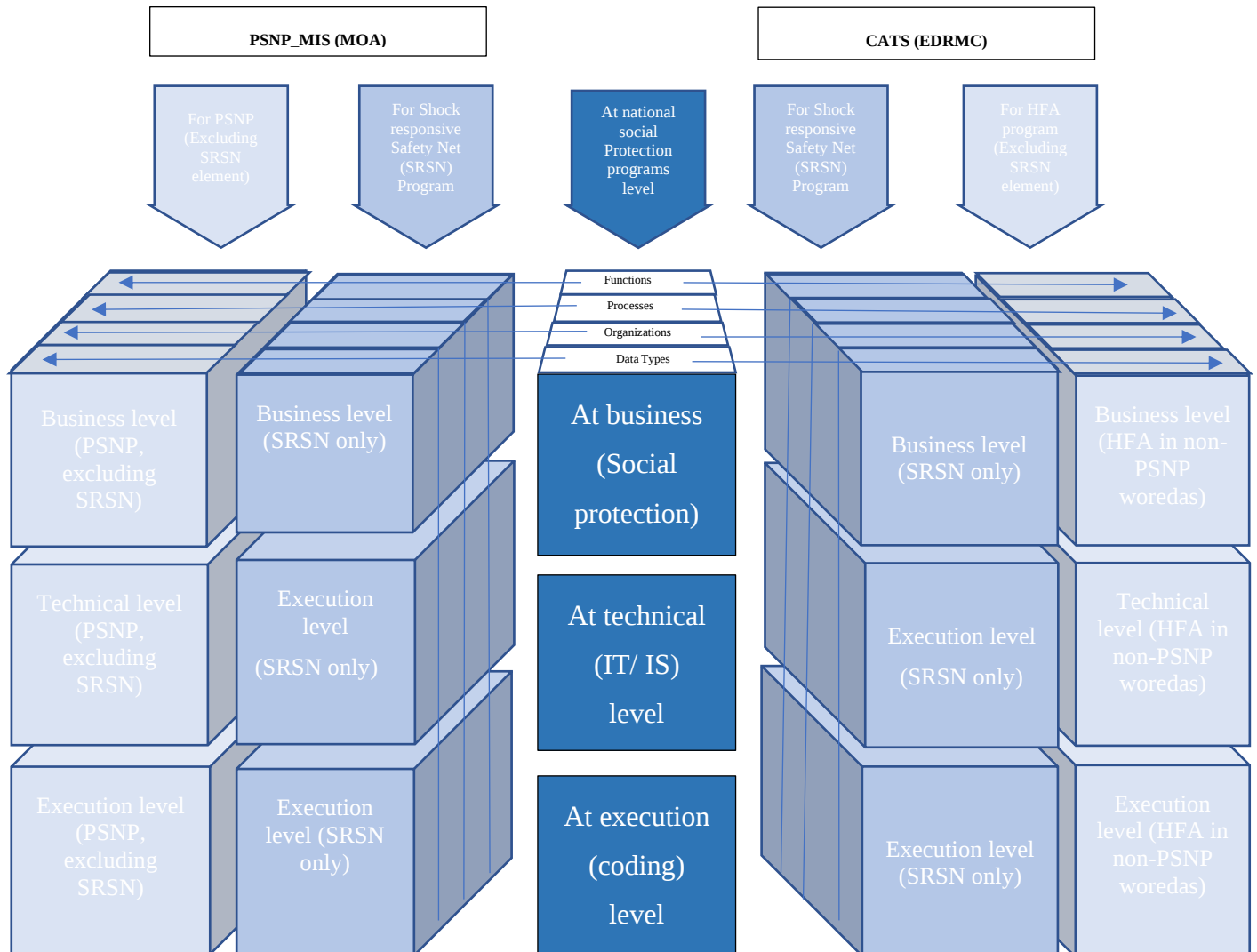
As shown in the framework, the two institutions have similar as well as unique business functions and processes. In relation to this, they have similar data needs and generate output for somehow related performance indicators. However, in few cases, the two programs have unique data needs which is in fact linked to the difference in their focus, selection criteria and duration of support.

On the other hand, the two programs have internal processes that only work for themselves (private space), common processes that they need to work collaboratively (public space) and common functions that social protection programs also share with. All showed a greater need and potential for the two MISs to interoperate both at business and technical levels.

The degree of abstraction is also required to be done at three levels. A conceptual model need to be first developed, describing the interoperability at general level. This needs to be followed by a more technical abstraction of the proposed architecture and then comes a more detailed

² The Humanitarian Exchange Language (HXL) is a standard in use by humanitarian agencies to speed up data processing and creates interoperability across their data sources.

coding for execution of the system. All levels of the abstraction requires identifying the private, public and global need that the two ISs have.



Adapted from AIOS framework by Zeimann

The detail of each of the components and sub-components of the architecture is described in the next section.

5.2. Description of the proposed Architectural Framework

5.2.1. Collaborative Business Axis

This is the very essence of interoperable MISs and foundation of an AIOS structure. This will also apply to the other two dimensions (enterprise and degree of abstraction) of AIOS. So, in

this section, we focus more on the general aspects of collaborative business axis. Then we see the detail of the private, public and global view dimensions of the remaining two axis.

As discussed in chapter four, there are a number of collaborative businesses that can be run by the PSNP and HFA programs. In general, the degree of collaboration between the two programs is mainly determined based on the type of social protection program they are undertaking, the type of disaster they deal with, and geographic location they are present. In terms of disaster, PSNP focus on drought induced effects, while HFA deals with all kinds of disaster including drought. Thematically, PSNP focuses on permanent support to food insecure population, whereas HFA provides live saving humanitarian support on temporary basis. In terms of geography, PSNP implements the SRSN elements in 485 woredas, whereas HFA intervenes in all woredas where emergency is declared. On that basis, we can then identify the private, public and global view of the interoperable SPIS as follows.

I. Private View

The private view of the two institutions is mainly related the exclusive focus of the two institutions. Hence, on the basis of the above demarcation of the two programs, the private view of the system for each programs would come to be:

Figure 17: Private view of the proposed interoperable SPIS

Parameter	PSNP-MIS	CATS
Geographic focus	PSNP target woredas	Non- PSNP target woredas
Cause of the humanitarian support	Drought (within PSNP woredas)	Disasters other than drought (within PSNP woredas)
Duration of support	Permanent support	Temporary support in non-PSNP woredas

This means that:

- PSNP would not view and manage data on humanitarian support implemented in non-PSNP woredas of the country
- HFA would not view and manage data on permanent support extended as part of PSNP in PSNP target woredas

II. Public View

The public view of the interoperable SPIS would be the SRSN element of PSNP. This is actually the HFA component of PSNP, meaning both institutions have part in implementation

of this component. Thus, all SRSN supports provided as part of PSNP would be jointly viewed and managed by both PSNP-MIS and CATS. This includes:

- The temporary support provided to PSNP target households in PSNP woredas
- The temporary support provided to non- PSNP target households in PSNP woredas

This is supported by the “one operator per woreda’ principle agreed by the two institutions. This means, it is either MOA or EDRMC that would provide humanitarian support to the needy per woreda. Accordingly, in case of emergency, MOA would reach out to both PSNP and non-PSNP beneficiaries in 485 PSNP target woredas, and this data would be available and seen by EDRMC as this is a humanitarian support run by MOA.

III. Global View

The global view refers to the collaboration of the two interoperable MISs with other external MISs. As such, the proposed architecture requires to have linkage with the below national MISs. This is believed to happen assuming that all national MISs would be using the national digital identity number for all their beneficiaries.

Table 16: The Global view of the proposed interoperable SPIS

No	Name of the MISs	Key points for Collaboration
1	Health Management Information System (HMIS)	Health insurance program
2	Education Management Information System (EMIS)	School feeding program
3	Agriculture Management Information System (AMIS)	Rural safety net programs and their social services/ supports
4	Urban Productive Safety Net (UPSP) (MoWSA)	Urban safety net program beneficiaries and their services
5	Private organization Employees Social Security Agency (POESSA) data base	Pension/ social security of private employees
6	Public Employees Social Security Agency (PESSA) database	Pension/ social security of public employees
7	Prosecution Management Information System (PMIS)	Free legal service

This is not a complete list of MISs which can potentially be interlinked with the proposed interoperable SPIS. There are other systems on development and this can also be considered to be part of the global view. The identity number and list of target households and their dependents will be the global view of the two systems.

5.2.2. The Enterprise Dimension Axis

The enterprise dimension is seen mainly from the functionality side. Specifically, it describes the distinct views on functions, processes, data, and organization elements of the envisioned system. To illustrate what the envisioned interoperable SPIS looks like, we see these enterprise dimensions vis-à-vis the degree of the collaborative business processes, i.e. which of the elements can be privately managed, jointly operated and publicly viewed.

I. The Function Dimension

The business functions of the two programs were discussed in detail in section____ of chapter four. As discussed there, the modules of PSNP-MIS and CATS are largely organized along with the programs core business functions. It was found out that the two programs have same, related and unique functions. These are outline below

- a) Private functions:** This refers to functions only applicable to either of two programs. Accordingly, the following functions are distinct to each of them:

PSNP (MOA)	HFA (EDRMC)
a) Permanent Direct Support (PDS) management	a) Early warning information and dissemination
b) Livelihoods Services	b) Commodity allocation and distribution
c) Grievance Redressal Mechanism	c) Stack/ warehouse/ hub management
d) Beneficiary graduation/ exit	

As can be seen from the above table, PSNP focus more on beneficiaries and the support provided to them, whereas HFA's focus is more on commodity allocation and distribution. As a result, Permanent Direct Support (PDS) management, livelihoods Services, Grievance Redressal Mechanism (GRM), and beneficiary graduation/ exit are distinct functions of PSNP. Whereas, early warning information and dissemination, and commodity allocation and distribution are the key functions unique to HFA. That means there is no need for interoperability PSNP-MIS and CATS on these areas.

b) Public Functions: This implies functions that work for both. As humanitarian interventions, both programs have many functions in common. These include:

- a) Beneficiary enrolment/ targeting (Entry, annual Updates & Exit)
- b) Temporary Direct Support (TDS)- cash or food transfer-**
- c) Shock Responsive Safety Net (SRSN)
- d) Public Work (PW) management
- e) Donation management/ resource mobilization
- f) Community Payment and reconciliation**

Of course, the selection criteria, longevity of and type of support varies for the two programs, but the above functions are all required by the two programs. Hence, the module related to these functions need to be seen and interoperated by both the two systems.

c) Global functions

What all social protection programs in the country are interested to share in common is the profile of existing and potential target households for their programs. Hence, registration of needy population becomes the global function in this case. For this to happen, there needs to be use of unique Id numbering and this could come from a central civic registry the country has just started or a central social registry that MOLSA is planning to develop. This means that the list of potential beneficiary would be globally viewed by not only by the two institutions, but also by MISs of other social protection programs.

II. The Process Dimensions

Business process refers to the steps and procedures that the two MISs pass through. In terms of this, the following are the key processes that are unique to each program, common to both, and common to other social protection beyond the two.

a) Private Processes

The following are list of processes distinct to each of the two programs for which there is no need for interoperability of the two systems.

Table 17: List of private processes distinct to each of the two programs

PSNP (MOA)	HFA (EDRMC)
a) Development of DRAP based on EW dashboard b) Trainings and community awareness programs	a) Seasonal and rapid assessments b) Early warning (EW) information and dashboard preparation

c) SRSN services d) Case management e) Payment and Reconciliation f) Monitoring and evaluation g) Reporting	c) Preparation of Humanitarian Response Plan (HRP) d) Donation management e) Allocation of commodities f) Dispatching g) Receiving h) Stocking i) Tracking of commodities
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b) Public processes

Processes that are common for both PSNP and HFA, and thus required to be interoperated by their MISs are the following:

- a) Selection of beneficiaries (based on selection criteria)
- b) Procurement of food for support
- c) Food transfer to beneficiaries
- d) Reporting

c) Global processes

These are processes that are required by social protection programs beyond PSNP and HFA. In our case, the main process that would be globally viewed in the interoperable SPIS is the registration and selection of beneficiaries.

III. The Data Dimensions

This is concerned with the type of data required by the systems and this can be both input and output from the system. The type of data to be privately, publicly and globally managed by the interoperable SPIS.

a) Private data

Data applicable to each of the programs are:

Table 18: Type of data privately required

PSNP (MOA)	HFA (EDRMC)
a) List of people receiving livelihood support b) Training participants c) Community event participant	a) Assessments results b) Early warning information c) Amount of commodities received, dispatched, stored and distributed up to warehouse level

b) Public data

Data related to SRSN component of PSNP is the is commonly needed by both programs. This include:

- Beneficiary profile- name, sex, age, household size targeted by SRSN component
- Address- region, zone, city, woreda, kebele, house number of those targeted by SRSN component
- Amount of food distributed as a temporary direct support and recipients in PSNP woredas
- Number of PSNP targeted people receiving cash support
- Kind of public work conducted and people participated

c) Global data

Type of data that are relevant beyond the two programs are

- The list and number of people benefited from the two programs
- The profile of households and their dependents supported through the two programs including the type of service they received

I. The Organizational Dimensions

There would be various organizations and work units expected to take role in the administration of the proposed interoperable SPIS. The following are the main business actors taking different role in the implementation of the system.

Table 19: the organizational dimension of the two programs

Level	MOA	EDRMC	Role
At federal level	FSCO- System Administrator	System Administrator	an actor with the administrator privilege and give user privilege for other actors of the system and also manage the interoperable system
	Program Staff:	Program Staff: System users	Access the interoperable system. They can also directly deal with the information system/data architecture based on the given user privilege.
At regional level	Data encoder	Store keepers/ Data encoder	Configure and consolidate beneficiary/ commodity data
At woreda level	Data encoder	Food Distribution	Configure and consolidate data Enter data and update.

		Point (focal person)	
At kebele/ community level	Selection Committee	Selection Committee	Selection of beneficiary based on given criteria and quota

As shown in the above table, there are multiple work entities responsible to manage the data from the federal to kebele level. Data about beneficiaries is first collected at kebele level, but this is kept in hard copy and then the officer responsible at woreda level will enter it into the database. Of course, these actors are only those directly involved in implementation of the two programs. However, as detailed in chapter four, many more actors including from across other organizations can have something to share to the interoperable SPIS, but this is all further dealt with in the case of integrated SPIS.

5.2.3. Level of Abstraction (Model Driven Development) Axis

The description of system elements on different levels of technical granularity supports a systematic development of CBP. This describes the different layers of interoperable systems. i.e. how interoperability happens at business, technical and execution levels. This usually start with the business requirements definition and go all the way down to the code level. However, as this study aimed for high level architecture of an interoperable SPIS, we would focus on the three basic levels of abstraction: at business level (CIM), at technical level (PIM) and at execution level (PSM).

I. At business level

The abstraction at business level, also called Computation Independent Model (CIM) or commonly as a business or domain model. It presents exactly what the system is expected to do by using the language understandable by the subject matter experts (SMEs). It is this model that is next translated into the remaining two levels of abstraction

The abstraction at business level requires to identify the conceptual private model, conceptual public model and conceptual global model. This is mainly done on the basis of the type of information the two MISs depend on.

Accordingly, the private level information for PSNP-MIS starts with registration of affected population and ends with graduation/ exit of target population. This would include registration, enrollment and update, public work attendance, payment, livelihood services, monitoring, reporting and graduation/ exit. On the other hand, the private level information for conceptual model on the CATS side starts with assessment and ends with closure of the emergency

response. This flow of information would also include early warning information and dissemination, donation management, commodity planning and allocation, commodity distribution at central, hub, warehouse and Food Distribution Center (FDC) levels, transportation/ logistics, and food distribution to beneficiaries.

The conceptual public model is concerned with the type of information in use by both PSNP-MIS and CATS. This conceptual model would detail how information related to food distribution at woreda/ Food Distribution Center (FDC) levels

The conceptual global model contains information that are complimentary not only for PSNP and HFA, but also with other social protection programs. Here, the common element for all is the humanitarian support at household levels.

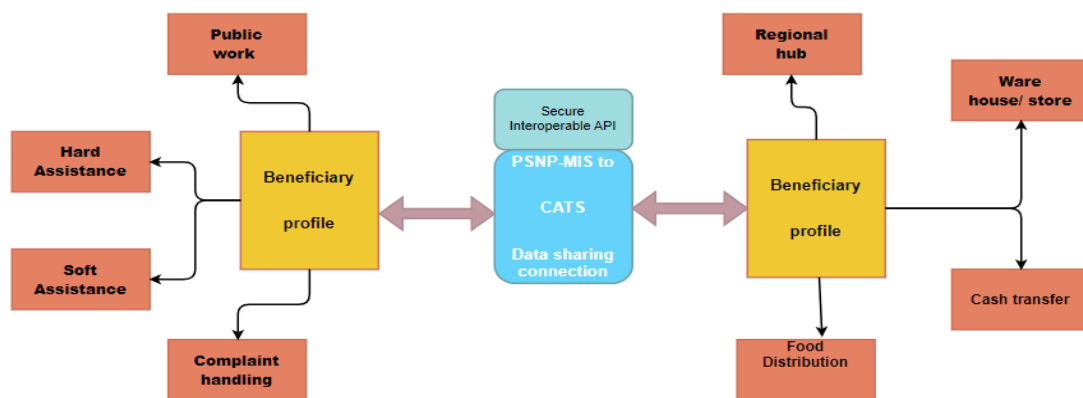


Figure 18: Conceptual model of the proposed architectural framework

II. At technical levels

Platform Independent Model (PIM) A PIM exhibits a sufficient degree of independence so as to enable its mapping to one or more platforms. This is commonly achieved by defining a set of services in a way that abstracts out technical details. Hence, in order to effectuate interoperability between the two systems, a model driven architectures needs to be used.

Specifically the PSNP-MIS uses MSSQL as back end and DotNet/PHP/Java as front end. Whereas CATS uses mainly JavaScript, Java Ruby and C#, there should be model transformation language to be used in order to transform messages from platform independent model to platform specific language. VIATRA or ATLAS can be options here.

This stage requires further scrutiny in to how the two MISs are currently operating and how they can best communicate one another including which model transformation is best to make them interoperable.

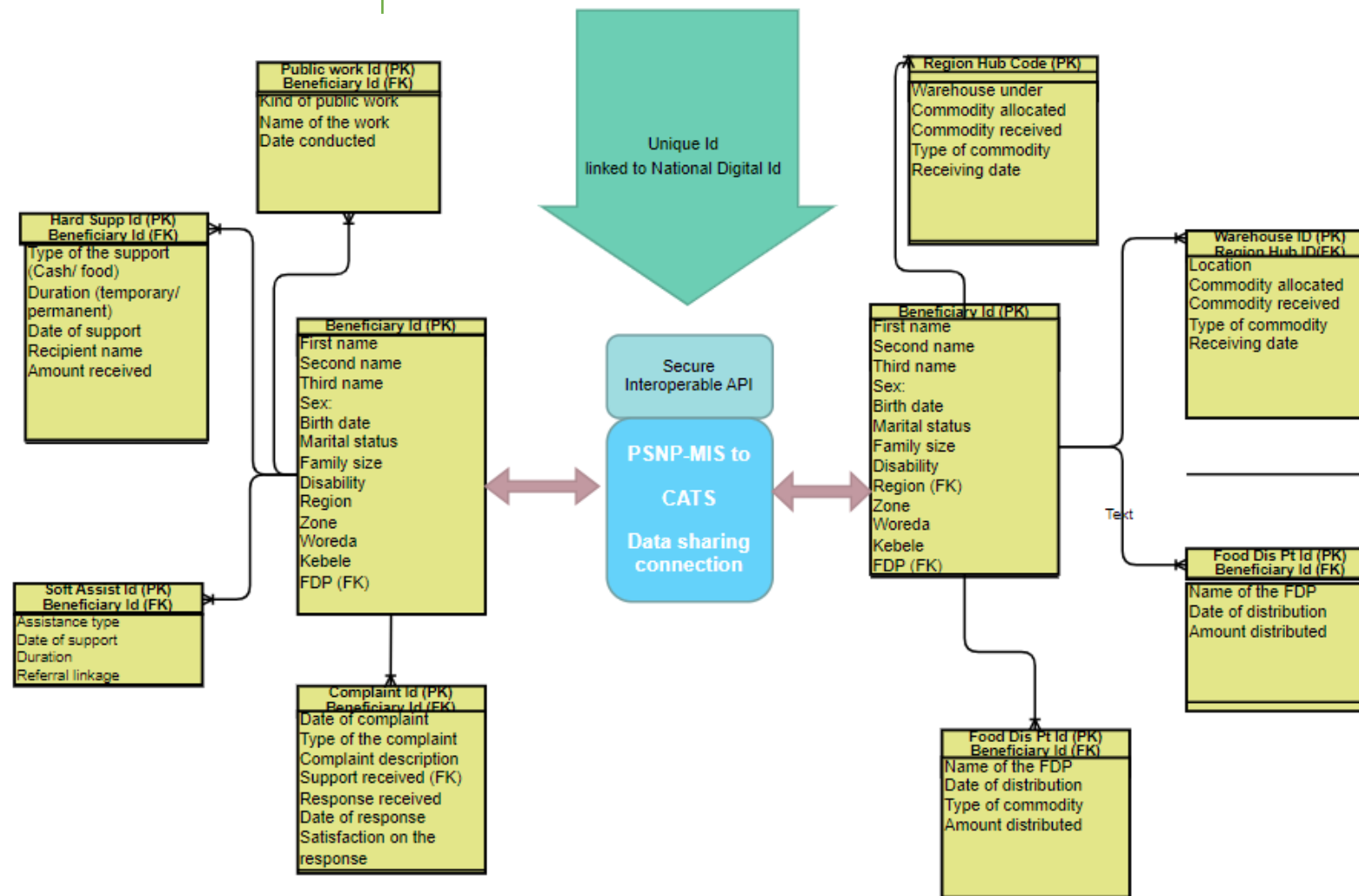


Figure 19: Logical data model of the proposed architecture

III. At execution level

Platform Specific Model (PSM) PSM combines the specifications in the PIM with the details required to stipulate how a system uses a particular type of platform. If the PSM does not include all of the details necessary to produce an implementation of that platform it is considered abstract (meaning that it relies on other explicit or implicit models which do contain the necessary details).

This is the start of the coding of the system. Thus, it would be worked out during the demonstration and implementation phase of the proposed framework

5.3. Technological Requirements for the Proposed Framework

As detailed in chapter four, a variety of technologies are required in order to effectively implement the proposed architectural framework. Generally speaking the technological requirement should strictly based on the EeGIF guiding principles and tools [21]. These have much to do with the principles set out in the EeGIF including data security and privacy, data security and privacy, information and data security, data security, access and authentication requirement, system audits for data security, data exchange protocol and data exchange mechanism, user interface requirements, online portal (mis web portal), email notification, query and advanced search, sizing, performance, load testing and scalability requirements, data backup and recovery requirements, technology platform requirements, electronic document management and tracking, hardware infrastructure and telecommunication networks

While the above aspects are to be further considered during the actual design of the system, however, the following points needs to be noted:

- The interoperable SPIS should be based on international best practices such as ISO 27001 on Information Security Management System (ISMS) from the International Organization for Standardization.
- The interoperable SPIS needs to adhere to the Data Protection Proclamation and the ICT data protection policy of the country
- It is a good opportunity that both MISs follow web-based architecture and must support industry standard enterprise RDBMS systems. The system should also work over the Intranet/Internet within both MOA and EDRMC
- The two MISs some differ in the technology used for back and front end. Thus, in order for them to interoperate, a middleware that is based on SOA would be required. To

facilitate this, a standardized data exchange protocol including the Humanitarian data exchange protocol needs to be used/designed, developed and implemented

- The system shall have a functionality to exchange data with other federal level MISs and databases in other institutions such as with National ID database, Birth registration database
- The security of the system needs to be provided at various levels and this should consider the organizational structure of the two institutions at federal, regional and sub-regional levels
- The interoperable system needs to provide a configurable facility to design and print reports for the two institutions as per their report needs
- The system needs to be capable of handling online functionalities for a database of at least 20 million people which is roughly the average population size exposed to different disasters in the country
- The choice of hardware resources (such as desktop computers, handheld devices, and laptops) should be guided by the application software requirements of the proposed interoperable MIS.
- The interoperable system would rely on the use of the existing communication infrastructure of the country, called WoredaNet which is provided by Ethio Telecom. So, given, the connectivity problems, the system needs to have both online and offline functionality at all levels

5.4. Validating the Architectural Framework

The proposed architectural framework was shared back to MIS professionals of the two systems and were asked how it would be workable for the purpose. Accordingly, respondents appreciated the initiative as it is timely and need based. For almost all of them, harmonization of the services by the two institutions is a priority agenda for the government. Hence, linking the two MISs to operate in tandem with one another is what the government is actually working towards.

Their reaction in terms of utility of the framework is also positive. According to almost all informants, the proposed framework would be quite useful to ensure data sharing between the two institutions and have quality report that is free from duplication. This would also help the government to produce better evidence for the use of funds from donor agencies.

The use of AIOS for the proposed interoperable in the way it delineates their area of functionality as private, public and global view would be in line of their institutional autonomy and ensures confidentiality of the data that each wants to keep of. In this regard, the grievance redressal and the case management aspect of PSNP would be areas that requires high confidentiality and thus would remain within the secrecy of the concerned institutions, i.e. MOA.

Most importantly, the current trend at the global level is going towards integrated system. In this regard, informants agreed that making PSNP_MIS and CATS interoperable would be an ideal start towards the envisioned integrated SPIS in the country. Relatively speaking, this is less costly and doesn't erode the institutional independence of the two organizations. Thus, it is workable, according to them

However, respondents are skeptic in some aspects, mainly from implementation point of view. Respondents mainly from NGOs partnering with the two institutions casted their doubt in functionality of the two systems. According to them, the gaps in the actual coordination between the two institutions in implementing the SRSN component would be an obstacle to instrumentalize the proposed system.

In addition, capacity limitation is identified as the other major challenge in translating the framework into the envisioned interoperable SPIS. The two institutions have different structure at various levels. For example, MOA has relatively strong presence up to kebele level, but this is not the case for EDRMC. Thus, the capacity limitation and the structural bottlenecks should be solved first according to these informants.

5.5. The value addition and contribution of the Proposed Framework

The research intended to propose an interoperable architectural framework for PSNP and HFA programs. In doing so, the research was guided by An Architectural Framework for Interoperable System (AIOS). What the researcher did was to customize AIOS to the context of the two programs. Basically, the researcher didn't come up with new framework, it has rather adapted AIOS in a way it serves interoperability between the two programs.

The research tried to show the information needs of the two programs on the basis of their respective indicators. It also uncovered how PSNP and HFA overlaps, which of their business functions are unique to them, and which are common for both; and which are also applicable

for any other social protection programs in the country. At the same time, the research identified the work units involved in the data management and processes align and which

All in all, what the researcher did was demarcating the private, public and global space for interoperability between PSNP-MIS and CATS. So, the value addition of the proposed framework is that firstly it identified the collaborative businesses between the two programs and secondly it shows how their MISs can technical work together without being altered. This means that the proposed interoperability framework can work with less cost and keeping the institutional freedom of the MOA and EDRMC.

5.6. Strength and Limitation of the suggested Framework

5.6.1. Strength of the Proposed Architectural Framework

The study has many strong sides. To start with, it is timely and need based. The government has put direction for the two institutions to harmonize their systems as they both reach out same woredas and at times results in duplication of beneficiaries. Hence, the contribution of the proposed interoperability framework, if implemented, would be highly supported by the two institutions and furthers their coordination and harmonization on implementation of their respective programs and common element, the SRSN sub-program.

In addition, as social protection programs, PSNP and HFA follows many similar functions. So, if we can make the two systems interoperable, it would be a good start to bring more actors into and which leads to an integrated SPIS in the country which is envisioned in the social protection polies and strategy of the country. In relation to the proposed interoperability would be scalable to more social protection programs and sectors which would potentially lead to one nationally led civic registry recently embarked by National Digital Id Service.

The very advantage of an interoperable MIS is it helps autonomous organizations to ensure data exchange and interoperability without changing their internal data management systems. As MOA and EDRMC are two independent government organizations, the proposed interoperable framework would be an ideal choice for both organizations.

5.6.2. Limitation of the Proposed Architectural Framework

The proposed architectural framework would not be implemented smoothly. There are some foreseen challenges to it. The institutional autonomy of the two institutions would be where the challenges start. Of course, one of the advantages of interoperable system is it works best

for autonomous organizations. But, in practical terms there is limited cooperation between the two institutions and this may hamper even the implementation of this study findings.

The capacity limitation especially within the EDRMC would be a critical challenge to implement the study recommendations. Though interoperable MIS is relatively less costly, it still requires some budget to instrumentalize the framework. So, budget limitation could be additional challenge on this.

The poor communication infrastructure in many of the woredas could also pose a challenge. The variation in the capacity of woredas could also make data integration and consolidation more challenging and even affect functionality of the system on timely basis. In relation to this, the two institutions have different structures across regions. For example, in Amhara DRM and PSNP are managed under same bureau, providing an opportunity to even further integrate their systems. But this is not the case in many other regions.

Most importantly, despite the commitment from the two institutions, both are fully functional, both institutions are still struggling to fully functionalize their respective MISs. Especially, the CATS is yet to reach the beneficiary level. So, the difference in the status of the two systems would definitely affect the operationalization of the proposed interoperable data management system too.

The social protection sector involves many actors. There are background donors behind the two main government actors. These have their own interest and at times come up with different demands whenever there comes new phase of PSNP and HFA programs. As this has implication for the system functionality, thus would require continuous changing the systems which would have budget and time constraints too.

CHAPTER SIX:

CONCLUSIONS AND RECOMMENDATION

6.1. Conclusions

Social protection encompasses a variety of social services provided by various institutions, both governmental and non-governmental ones. To this end, an integrated SPIS has been the trend across the globe. Developing an integrated SPIS has also had a policy back up in Ethiopia for years, and the government has embarked on establishing it back in 2016. However, let alone an integrated one, an interoperable SPIS even between PSNP and HFA, the two largest social protection programs in the country couldn't be realized. Hence, despite their overlapping geographic and thematic focus, the two programs continue to run independently by two organizations with no or limited data sharing between them, causing duplication of efforts and beneficiaries at national level.

As social protection programs, both PSNP pass through similar processes and their MISs have also more or less similar functions, though their focus and type of support vary. At the same time, the two programs have similar data/ report needs which in some cases is unique depending on their donors and purpose of their programs. Both programs also involve various work units from their respective organization and beyond, which some of them are common to both. Hence, collaboration between the two programs should start at enterprise level. Hence, by identifying the private, public and global spaces for each program, ensuring interoperability between their MISs would be achievable.

At the technical level, though the PSNP-MIS and CATS are developed in somehow different programming languages, interoperability between them is possible through adopting Service Oriented Architecture enabled by Model driven Architecture. The availability of standard data exchange protocols in general and that of the Humanitarian Data Exchange protocol (HDX) would be quite necessary to ensure effective communication between the two systems, and functionally harmonize implementation of the programs

Hence, it can be concluded that an AIOS based architectural framework for an interoperable SPIS for PSNP and HFA programs could be an ideal solution to ensure collaboration and data sharing between them without affecting their autonomy and independence or alter structure of their internal information management systems as well. As was also validated by users and administrators of the existing PSNP-MIS and CATS, the proposed framework can materialize the desperately needed interoperability between these two information systems.

Of course, this would not be easily achieved. Gaps pertaining to policy and operational matters, individual staff or institutional factors, and material, human and financial challenges would lie ahead in making it happen.. However, any stride towards such an interoperable MIS would also be a good starting point for the country to realize an integrated SPIS which it has long been envisioning.

6.2. Recommendations

The study concluded that interoperability between PSNP-MIS of MOA and CATS of EDRMC is necessary, timely and achievable to harmonize the implementation of the two closely related social protection programs as well. This would require an effective collaboration at business and technical levels. The recommendations should then focus on these two key dimensions of interoperability. With that in mind, the following recommendations are suggested to translate the proposed framework into the actual interoperable SPIS in the country :

- The proposed interoperable SPIS requires enactment of a collaborative business process. Hence, the two institutions should first assess, discuss and enact the areas of collaboration between them;
- The implementation of the proposed interoperability framework should be strictly guided by the EeFIF and its guiding principles, procedures
- procedures It is advised that the two institutions should capacitate their MIS units at all levels so that they can support full implementation of the proposed framework
- Two different vendors are currently rolling out the two systems and are expected to continue supporting for the next couple of months. So, to effectuate the interoperable system, MOA and EDRMC should also work with the vendors so that any intellectual property right couldn't affect implementation of the framework.
- The proposed system doesn't much require change in the structure of their internal data systems. However, if this is required based on further research, the two institutions need to commit to make that change too;
- Most importantly, there is still on and offline functionality of the two MISs. Thus, for better result, the two institutions should first ensure the full functionality of the systems
- Use of similar or closely related indicators is among the driving factor for interoperable SPIS. Hence, the two institutions should standardize their indicators and harmonize their data needs in case of similar indicators. This should be negotiated with donors of both programs as well

- A development of an advanced MIS would be nothing without having qualified IS professionals at all levels. Thus, along side working on the interoperable SPIS, both institutions should work to equip their MIS professionals upto woreda level and ensure the necessary institutional structure is in place too;
- The proposed architectural framework; if realized, would have some use for other social protection programs like health insurance, school feeding, social security, etc too. Hence, these programs need to also consider interoperability for themselves and link their systems with the nationally envisioned integrated SPIS.

6.3. Future Works

As it was made in the scope and methodology section, the main focus of this study was to propose an architectural framework that could help to interoperate MISs of Ethiopia's PSNP and HFA programs, the two largest social protection programs in the country. Accordingly, the study showed that PSNP-MIS of MOA and CATS of EDRMC essentially require interoperability and proposed an architectural framework to that effect. The proposed solution was also validated positively by administrator and user of both MISs. However, this should only be considered as an eye opener study in the area of interoperability research in the country, and actualizing the system itself requires further work. This include among others:

- A more rigorous study that would go deep into technical and technological dimessions of such interoperability SPIS should be conducted so as to refine the proposed architecture as need be;
- Likewise, a more detailed organizational study focusing on the business processes and structures of the MOA and EDRMC is required to solidify the collaboration of the two independent institutions;
- The two systems, though have gone operational, are not yet fully functional across all regions and woredas and are being continuous updated based on feedback from users, requiring to wait for more time to do the above suggested studies
- Both target institutions have also other MISs serving their different work units. Hence, future studies on the matter should also bring other MISs used by the two institutions into the interoperability research
- Interoperability between the two MISs at 'global' level takes them into national civic and social registry as well as MISs of other social protection programs, revealing the need to assess the status of these national register and databases in the future;

Annex- Data Collection Tool

Research Tool I

A Study on “**Architectural Framework for Interoperable Social Protection Information System (SPIS) in Ethiopia: The Case of Productive Safety Net Program (PSNP) and Humanitarian Food Assistance (HFA) Programs**

In-depth Interview Guide (With MIS Professionals)

Introduction

This interview guide intends to collect data for the aforementioned study that aims to propose an architectural framework that can be considered for interoperable MIS for Productive Safety Net Program (PSNP) and Humanitarian Food Assistance (HFA) programs implemented by Ministry of Agriculture (MOA) and Ethiopian Disaster Risk Management Commission (EDRMC) respectively.

You are selected to be informant for the study based on your familiarity on the study subject. Your information would be highly useful to achieve the study purpose and the interview will not take more than 45 minutes. Hence, we kindly request you to provide us your consent to participate in the study and candidly provide us your response to the below questions

Thanks for your cooperation in advance!

Part One: Background Data

- 1.1. Interview # : _____
- 1.2. Age : _____
- 1.3. Sex : M/ F: _____
- 1.4. Job position: _____
- 1.5. Higher level of education completed: _____
- 1.6. Total work experience in years: _____
- 1.7. In which program you work: PSNP __ HFA programs: _____
- 1.8. Your task or role linked to PSNP/ HFA _____

Part Two: Technical Questions on AIOS (Enterprise Modeling)

- 2.1. What type of information do you need for your program management?
- 2.2. What type of information do you require to collect and what attributes do you use to describe/organize them?
- 2.3. What are the steps you follow to accomplish your task for data collection, analysis and reporting?
- 2.4. Are you satisfied with the information outputs provided by the existing MIS? If yes/ No, how/ why?

- 2.5. What additional information should the MIS provide and which are not provided at present time?
- 2.6. Which of social protection functions (enrolment, registration, cash/ food deliveries, grievance handling, etc) do you think overlap with adjacent functions of PSNP/HFA and how?
- 2.7. Which work unit is responsible to lead/ coordinate the data management processes within and with other collaborating partners at different administrative levels?
- 2.8. How is the existing level of collaboration between PSNP and HFA programs in terms of information exchange?/ what information do you exchange with other program?
- 2.9. Which type of information do you think should be privately kept by the program, and which type of information can be public?
- 2.10. What guidelines /policies your organization use to govern management/sharing of information?
- 2.11. What IT infrastructure (IT system/ software/ platforms/ hardware, etc.) are used for collection, storage, process, analysis, and access the data/ infrastructure?
- 2.12. Do you feel that interoperability between MIS of PSNP and HFA is a need for your organization at present? Why and how?
- 2.13. Do you see any concern if PSNP and HFA use the MIS of PSNP and HFA programs?
- 2.14. . What additional suggestions do you have to improve services of MIS?

Thanks once again for your cooperation!

Research Tool II

A Study on “**Architectural Framework for Interoperable Social Protection Information System (SPIS) in Ethiopia: The Case of Productive Safety Net Program (PSNP) and Humanitarian Food Assistance (HFA) Programs**”

In-depth Interview Guide (With Program Managers/ MIS Users)

Introduction

This interview guide intends to collect data for the aforementioned study that aims to propose an architectural framework that can be considered for interoperable MIS for Productive Safety Net Program (PSNP) and Humanitarian Food Assistance (HFA) programs implemented by Ministry of Agriculture (MOA) and Ethiopian Disaster Risk Management Commission (EDRMC) respectively.

You are selected to be informant for the study based on your familiarity on the study subject. Your information would be highly useful to achieve the study purpose and the interview will not take more than 45 minutes. Hence, we kindly request you to provide us your consent to participate in the study and candidly provide us your response to the below questions

Thanks for your cooperation in advance!

Part One: Background Data

1.1. Interview # : _____

1.2. Age : _____

1.3. Sex : M/ F: _____

1.4. Job position: _____

1.5. Higher level of education completed: _____

1.6. Total work experience in years: _____

1.7. In which program you work: PSNP ___ HFA programs: _____

Part Two: Technical Questions on AIOS (Enterprise modelling)

- 2.1. What type of information do you need for program management of PSNP/ HFA?
- 2.2. Which of the social protection functions (enrolment, registration, cash and food deliveries, grievance handling, graduation and exit, etc) are actually served by your MIS?
- 2.3. Which of social protection functions (enrolment, registration, cash/ food deliveries, grievance handling, etc.) do you think overlap with adjacent functions of PSNP/HFA and how?
- 2.4. How is the process of the data management? Who will do what?
- 2.5. Which work unit is responsible to lead/ coordinate/ the data management processes within and with other collaborating partners at different administrative levels?

- 2.6. Are you satisfied with the information outputs provided by the existing MIS? If yes/ No, how/ why?
- 2.7. What additional information should the MIS provide and which are not provided at present time?
- 2.8. What guidelines /policies your organization use to govern joint implementation and management/sharing of information?
- 2.9. What is the required level of collaboration between PSNP and HFA programs in terms of program implementation and information exchange?
- 2.10. Which type of information do you think should be privately kept by the program, and which type of information can be public?
- 2.11. Do you feel that interoperability between MIS of PSNP and HFA is a need for your organization at present? Why and how?
- 2.12. Do you see any concern if PSNP and HFA use the MIS of PSNP and HFA programs?
- 2.13. What additional suggestions do you have to improve services of MIS?

Thanks once again for your cooperation!

Research Tool III

A Study on “**Architectural Framework for Interoperable Social Protection Information System (SPIS) in Ethiopia: The Case of Productive Safety Net Program (PSNP) and Humanitarian Food Assistance (HFA) Program**”

Discussion Points for Validating the Proposed Framework

Introduction

The purpose of this evaluation interview is to validate if proposed architectural framework for an interoperable **Social Protection Information System (SPIS) for PSNP and HFA** programs implemented by Ministry of Agriculture (MOA) and Ethiopian Disaster Risk Management Commission (EDRMC) respectively.

You are selected to be validator of the proposed framework on the basis that you are either system administrator/manager or user of the MIS if it becomes functional. Your information would be highly useful to achieve the study purpose and the interview will not take more than 20 minutes. Hence, I would like to request your consensual, candid and honest response to the below questions.

Thanks for your cooperation in advance!

1. Do you think interoperability between MISs of PSNP and HFA programs is relevant, timely and feasible initiative?
2. Did you find the proposed architectural framework for an interoperable MIS for PSNP and HFA programs useful?
3. If the proposed architectural framework for interoperable MIS for PSNP and HFA programs is implemented, will you use it?
4. What feature of the proposed architectural framework you expect to be removed, modified or added to make the interoperable MIS more useful?
5. What challenges do you see in putting in place and use the proposed architectural framework for an interoperable MIS for PSNP and HFA programs?
6. What do you suggest as system administrator/ user to operationalize the proposed architectural framework into an interoperable MIS for PSNP and HFA programs?
7. What is your overall opinion on the architectural framework proposed for interoperable SPIS?

Thanks once again for your cooperation!

Research Tool IV

A Study on “Architectural Framework for Interoperable Social Protection Information System (SPIS) in Ethiopia: The Case of Productive Safety Net Program (PSNP) and Humanitarian Food Assistance (HFA) Program

Observation Checklist

Part I- To understand the nature of the two MISs

- 1.1. The completeness and adequacy of the user manuals of the two MISs.
- 1.2. The different modules of the MISs
- 1.3. The type of information is kept in the two MIS
- 1.4. Level and ways of accessing the MISs
- 1.5. The programming language used to develop/ update the MISs

Part II- To see potential for interoperability between the two MISs

- 1.6. Level of functionalities of the MISs to import and export features
- 1.7. Storage method of each MIS
- 1.8. Dis/similarity of information/ reports being stored/ produced by the two MISs

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