Technical Report: A Semi-Structured Interview on Test Data Need in The Integration Testing with the Norwegian National Registration

Abstract

This paper reports a case study for test data need for integration testing in Norwegian public sector. The integration testing among the organizations in public sector are challenging, and big part of the challenges lie in test data generation and uses. We believe many test data challenges are in common across organizations. By Studying five major Norwegian public agencies and one major data distributor for many organizations in public sector, this case study aims to find out common test data challenges in the studied organizations.

Keywords: Synthetic data generation, Test data need, Case study, interview

1 Introduction

The Norwegian government holds high ambitions for modernizing, simplifying and improving the public sector by using ICT1 and digitalization. In recent years, the development of the electronic management of the Norwegian government focuses on common ICT components for public sector as a key principle [**?**]. The Agency for Public Management and eGovernment (Difi) defines common components as components of IT solutions that can be co-used or reused in several IT solutions in the public sector [**?**].

In line with this principle, the Norwegian public sector has established a number of open, reusable solutions that cover typical digitization needs, such as login, authentication, registers, etc. As shown in Figure 1 the national common components include the National Registry for information of the population, the Central Coordinating Register for Legal Entities (CCR) in both public and private sectors, the ID-porten as a common log in solution to public services, etc. These national common components help the organizations and businesses focus attention on their own professional challenges instead of common functionalities. They also help provide residents with more unified services across the public administration. To provide information and services, the IT systems of the common components have complex integrations with many systems of organizations from both the public sector and private.

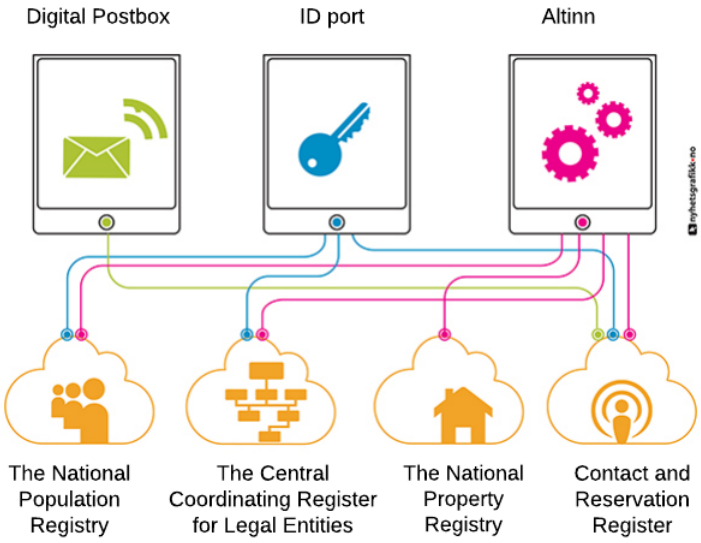

Figure 1: National Common Components in Norwegian public sector

The integration of the IT systems of Norwegian public sector are complex. The integration around the National Registration is one example that pictures the complexity of the integration in the Norwegian public sector. The National Registration holds the personal information of the population as an example. Most public agencies rely on quick and easy access to the updated and accurate personal information to perform their tasks. Over 900 agencies in the public sector receive data from the National Registration through data distributors. The number of user identities are approximately 23.000, and the annual number of person-level lookup is about 20 million. These numbers do not include the big national administrations like the Tax Administration and the National Labour and Welfare administration (NAV), who maintain their own copy of the National Registration locally. NAV alone have 220 million annual lookups in its own copy [**?**].

Apart from information output, the National Registration also receives information from other public agencies and administrations, among others, NAV, the Norwegian Directorate of Immigration (UDI), the Norwegian Mapping Authority, Difi, The Norwegian Directorate of eHealth (eHelse), etc. There are some administrations, for example NAV, both receive from and send information to the National Registration. There is also circular information flow among these public organizations, for example, the Tax Administration receives data from the National Registration, and NAV receives data from the Tax Administration, while the National Registration also receives data from NAV.

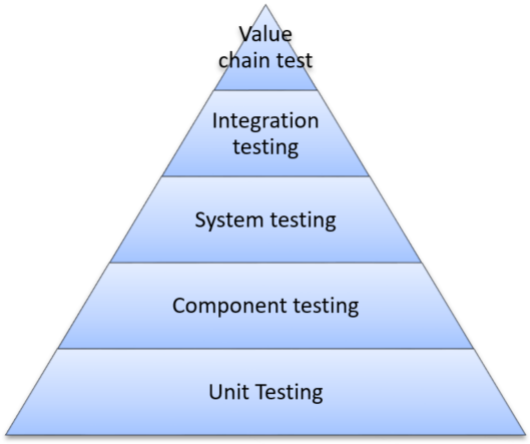

Figure 2: Test Pyramid

The complexity of integration makes the integration testing complex. Testing is crucial to quality assure the integration between the systems in the public sector. Figure 2 shows the modern conceptual pyramid of the different levels of software testing. The pyramid starts from the unit testing on the lowest level, which is testing on the level of code units. The component testing and system testing is about the testing of the software module components and the software system that consists of module components. The integration testing is about the testing of integration between systems, and the value chain testing is the testing of business scenario that evolves multiple systems. In this study, we focus on the levels of integration testing and value chain testing in the Norwegian public sector.

The complexity of the integration makes the integration testing complex. The Integratin testing needs to assure that all the information flow and the interaction between systems function as they should. The integration testing also need to assure that the information and services provided are of sufficient quality to support the function of the receiving system.

The National Registration has a modernization project, Modernisering av Folkeregisteret (MF) that aims to modernize the registry that meets the requirement of new law on population registry. The new law gives easier access of information, new information become available, fewer confidential, and clearer about what information is confidential [**?**]. There is a work group with representatives from the integrating organizations of public sector. Through this work group, these organizations collaborate to address the complexity of the integration testing. There are two aspect of integration from MF perspective. One aspect is the integration with the organizations that send information to the National Registry, which are referred as information producer of MF. The other aspect is the integration with the organizations that receives information from MF, which are referred as information consumer of MF. The work group

decided that MF provides a producer test environment, and a consumer test environment to address the two aspect of integration needs.

Test data is a central part of the building of these test environments. Large part of the IT systems in the public sector are information management systems, which means software systems that are designed to facilitate the storage, organization and retrieval of information. The integration between the previously mentioned organizations, for example, the National Registration, NAV, UDI, Difi and CCR, are all integrations between information management systems. To test such integration, test data is of primary importance. The integration work group of MF have decided that the consumer test environment of MF will use synthetic test data. Although the reasoning behind this decision is out of the scope of this study, we agree that the synthetic data is the best choice for this purpose. Under the regulation of GDPR[1] , for security and privacy protection, production data should not be used in testing. Anonymized production data can be good choice for component and system testing within an organization, but subjects to many law and regulation in the scenario of cross organization integration testing. Synthetic data, that is fictive data with no root from reality and comply with GDPR and other security and privacy protection regulations, can potentially meet the challenges for test data in integration testing in Norwegian public sector.

We find out and summarize test data need for integration testing through this study. The name of this study is the Case Study for Mapping Test Data Need in Cross Organization Integration Testing in Norwegian Public Sector, here after referred as case study for g test data needs. The main purpose of this study is to find out requirement for the synthetic test data for this consumer test environment of MF. Besides the main purpose, the study also try to identify any necessary facilitation to make such data accessible and usable, and any impact on testing practice to the organizations to adopt and use such data.

The case study for mapping test data needs is a first step and the foundation of a research project Evogent – Evolutionary Data Generation for Testing. The goal of Evogent is to provide method and tool prototyping to meet the test data need in cross organization integration testing in Norwegian public sector with model based techniques. Evogent collaborates with MF under an action research approach. The case study of test data need is an exploratory study in the context of integration testing of Norwegian public sector. The study takes an interpretive perspective and aims to understand and describe the issues in its context. This study use semi-structured interviews to collect information about testing and test data need from involved organizations. We took transcripts from these interviews, summarized them and analysis them.

In this study, we interviewed test personal from six organizations. Five of them are government organizations: The Norwegian Tax Administration

[1]GDPR stands for the General Data Protection Regulation, a new set of rules desigend to give EU citizens more control over their personal data.

(Skatteetaten), The National Labour and Welfare Administration (NAV), The Brønnøysund Register Center (Brreg), The Norwegian Directorate of eHealth (eHelse), the Agency for Public Management and eGovernment (Difi), and one private IT company Evry which is the data distributor of the National Registry. The interview participants from these organizations are test developers and test leaders that work either with internal testing of the organization or integration testing with other organizations, or both. Some of them have dedicated responsibility for test data.

We found that to support the integration testing of Norwegian public sector, synthetic data that is statistically representative of real population data is very welcome. Synthetic events that happens to these test persons are also important. Furthermore, to be able to use the synthetic data, a search function on top of the data would be necessary for all. In addition, most organizations will need adaption of their existing test practice to be able to use the consumer environment and the synthetic test data it provides.

We also found conflict of interests among these organizations regarding the synthetic events. Some organization would like to have control over the synthetic events that happens to the synthetic population, while other organizations would prefer the synthetic population and events reserve the statistical representativeness as real population data. This conflict of interest and possible solutions are discussed in the Result and Analysis section.

This paper reports the study results. The contribution of this paper will be using case study method for mapping test data need across organizations that have integrating systems, and the charted test data need for integration testing for major Norwegian public agencies under modernization. In addition, this paper discusses identified conflict of interesting in test data need and point to possible solutions to balance such contradiction.

In the rest of this paper, we discusses method and design of this case study in Section 0.2, and presents the study results and analysis in Section 0.3. Section 0.4 summarizes and concludes this study.

2 Method and Case Study Design

Case study is natural choice of method to study an issue in its context [**?**]. Case study is an empirical method aimed at investigating contemporary phenomena in their context. The case is referred to as the object of the study (e.g. a project), and it contains one or more units of analysis (e.g. subprojects). Data is collected from the subjects of the study, i.e. those providing the information. Data may be quantitative (numbers, measurements) or qualitative (words, descriptions). A case study protocol defines the detailed procedures for collection and analysis of the raw data, sometimes called field procedures [**?**].

The context of this case study is the integration of Norwegian public sector, and the case is the test data need to test this integration. This case study contains six study units, which are the integrations between MF and the six

organizations mentioned in the previous section. This study consists of two activities, data collection and data analysis. We first collected data through semi-structured interviews from the study units. We an interview guideline describing what information we collect, how we collect them and how we will analysis them. The interview guideline serves as a case study protocol. Then we analysed the collected data to find out the common test data needs, and any needs that are specific to certain study unit. Through the analysis we also attempt to map out the reason behind the needs from both technical and project and process perspective.

The purpose of this study is exploratory, which is to find out the test data needs in its context. The approach of this study is interpretive, which is to understand and describe the issues instead criticizing existing solutions or practices.

2.1 Data collection

The data collection method of this study is semi-structured interviews. In a semi-structured interview, questions are planned, but they are not necessarily asked in the same order as they are listed. The development of the conversation in the interview can decide which order the different questions are handled, and the researcher can use the list of questions to be certain that all questions are handled. Additionally, semi-structured interviews allow for improvisation and exploration of the studied objects [**?**].

In this case study, we have pre-defined questions in the interview guideline that are sent to interviewees before the interview. During our interviews, we use the questions in the guideline to direct conversations, and we allow deviations when we come to interesting topics that are not on the question lists. We also allow dropping of some questions if they are not applicable to the study unit under interview.

For each interview, we take a written transcript of the conversation as detailed as possible; we also took audio record with consent from all participants to help supplement the written transcript. After each interview, the transcript was sent to the interviewees for comments and supplements before analysis of it.

2.2 Data analysis

For this case study, the data are the six interview transcripts from the interviews. The data analysis process contains three steps: reorganization, summarization, and abstraction.

These transcripts are sentence-to-sentence notes of the interview conversation. Due to the loose structure of the semi-structured interview, the texts of the transcripts are loosely organized, with topics and ideas not necessarily linked together in a systematic way. To analysis these data, we first went through each transcripts and reorganized the texts according to the pre-defined questions. We also reorganized topics and ideas that are not closely linked to any

pre-defined questions, and group them into groups. After reorganization, we summarized the contents about each questions and under each topic groups for each transcripts. We then listed the summarized contents of all transcripts in a table, where each row contains one question or topic group, and each column is the content of one transcript. From the this table we abstract our conclusions.

2.3 Interview Design

We use a pre-defined interview guideline. The guideline consists of an introduction to the case study and an interview question lists. The questions are grouped into three sections. In the first section, we focus on questions about the systems under test, general testing practice in the organization, and general test data need both within their organization. The first section contains five questions and serves to set the unit study into the context of the organization and its systems. The second section has six questions, and focuses on integration testing with the National Registration, where we ask about test process and practice of integration, test data need and challenges for the integration testing, and status and plan of modernization projects of the system if any. Questions in the section ask about concrete test data need in the consumer environment of MF. The questions are domain specific to the organization under interview, and with detail level of variables and data field in database.

We sent out uniformed invitation with attached interview guideline to selected consumer organizations of the National Registration. We stated in our invitation that we would like to invite at least two persons from each organization to a two hours interview session. The participants from the organization, or interviewees, are expected to have testing expertise, and are familiar with the data model of the system and the integration with the National Registration. In each interview session, there are at least two participants from the case study, or interviewers. One of the interviewers are dedicated for scripting, and one of them focus on steering the conversation with the interview questions. During the interview session, all interviewees are welcome to answer all the questions, and all interviewers have freedom to ask follow-up questions about any topics that are interesting to the case study. After each interview, we sent the transcripts taken during the interview session to the interviewees for correction, clarification or supplement.

3 Results and Analysis

We sent out invitation to ten major consumer organizations of the National Registration, and six of them responded and arranged interview sessions. The names of these organizations are listed in Section 1. Apart from one organization, eHelse, all the other organizations have at least two interviewees. We analysis the collected data with the process explained in Section 2.2. The reorganized and summarized data can be found on our project home page `https://testifyas.atlassian.net`. We abstract the following findings from

the summary.

3.1 General testing process and practice

3.1.1 The software systems of the study units are complex

All the units have more than one systems that have different functions. Apart from Evry, which is a data distributor of the National Registration, all the other organizations have at least one register, and multiple data bases. For example, NAV has 248 internal databases and Brreg has 18 registers. All the study units provide more than one services to either organizations or individuals. For example Altinn, the digital platform for government service maintained by Brreg, has 47 serve providers.

3.1.2 Different systems have different testing process and practices

Organizations with many software systems, eHelse, NAV and Brreg, have many different approach of development and testing. And thus have many different test practices with the organization. The development methods range from traditional waterfall approach, to extreme agile approach as DevOps. This reflects on the testing practices. Some systems have several release yearly with planned system testing, integration testing and acceptance testing period of several weeks, while others adopt more automated continuous testing with several releases a day.

3.2 Challenges and need in test data

3.2.1 Organizations want to avoid production data in testing totally

The main test data form of the organizations are anonymized data and fictive or synthetic data. However, in some singular scenarios, for example complex fail situations in production, or very complex cases, they have to use production data to test the specific situation in restricted test environment. All of the organizations would like to totally avoid production data if possible.

3.2.2 Synthetic data of test population that is statistically representative to the real population is welcome

A part from Difi, All the organizations would like to have synthetic data of population that is representative to the real population in their integration testing. Synthetic data for population will include all type of information reside in the National Registry, for example, name, gender, ID number, address, marital status and family relation etc. The Tax Administration, eHelse, NAV and Brreg, would like to have the synthetic data to be statistically representative to the real population. And the reason why they need statistical representativeness is that they have very complex regulations that they do not have an overview

to make thorough test case analysis on. Since all the regulations for the information of the population, a synthetic population that is statistically similar to the real population will most possibly cover all the regulations. Evry is a data distributor for many organizations in public sector, including the National Registration. They have customers that obtain data from them from both public and private sectors and the need for test data of these customers varies. For Evry, a synthetic test data similar to real population will enhance the service they provide to their customers. For Difi, such a synthetic population will not add much value because their take only ID number and address for testing, and only need the test data covers all the test cases around these two information. Their current test data covers these needs already. It is important to have synthetic events that happen to the synthetic population.

3.2.3 The synthetic data should also provide case and events that rarely exist or happen in reality

The Tax Administration, NAV, eHelse and Brreg expressed that they would have case and events that rarely exist or happen in reality. For example, the Tax Administration would like to have the synthetic event of bankruptcy of the Norwegian Central Bank, to test that their systems can handle such situation. NAV would like to test the registration of birth of triplets, one baby before midnight, one baby right on midnight and one baby after midnight. These events do not happen yet, or do not happen often in reality and are difficult to find test data for them. Synthetic data can possibly simulate rare situations and meet this need.

3.2.4 It is desirable to have the synthetic data synchronized across other organizations

The organizations in public sector have different functions and collaborate to provide services to the society. When one event happens it may triggers actions in multiple organizations. The birth of a baby will involve at least eHesle, NAV and the National Registry. There it is desirable to have the synthetic data and events synchronized across organizations to support the testing of such scenarios.

3.2.5 Synthetic events that happen to the synthetic population are important

All the participating organizations express that they would like to have synthetic events, for example, birth, death, moving of address, change of marital status, immigrant and emigrant, etc. Events are crucial to test the functionality of their systems. To maintain the statistical representativeness, the synthetic events should be generated according to a statistical model so that it is also representative to the events happen in real population. We refer to the synthetic data that have synthetic events happen to it as synthetic dynamic data.

3.2.6 There are conflict interests in test data need

Among the six participating organizations, the Tax Administration and NAV express that they would like to have control of the synthetic events, and to trigger the events they want by themselves. While eHelse, Brreg and Evry would like that the synthetic test population and events should maintain statistical representativeness. These two needs are conflicting because if the synthetic events are triggered according to specific test need, and not generated by statistical model, the synthetic population will gradually lose the representativeness. This conflict and possible solutions are also discussed in one of the interview session. The wish to have control over events is related to the test strategy of the organization; whether the organization needs control over events in a test environment depends on what type of test to run in this environment, and what test approach to take. If the organization can adapt to a test approach that the tests are triggered according to type of events they receive, they could possibly run regression test without triggering specific events by themselves. Another possible solution would be building extra technical solution, for example, a proxy between the data source and the system to control what events can arrive at the system under test, and what event should be stopped. To find solution for conflict interest is not the scope of this study, but these discussions point at directions that can be further researched.

3.3 Test data facilitation and impact on test practice from the consumer environment

In the interviews, we also discussed necessary facilitation for the synthetic data to be usable, and the impact on test practice of using them. All organizations express that a search function is necessary. The synthetic data should be searchable by criteria, for example, female of age between 25 and 45 with three children, or 6 years old boy living in a certain school district. Some of the organizations need to change their test practice to take use of the synthetic. One outstanding change needed is the way they specify test data. Some organizations have test data specified in their test cases as with criteria, which make it easy to adapt to synthetic data with search function. There are other systems specify test data with concrete IDs. These tests may fail since the status of a person with specific ID may change in a dynamic synthetic population.

4 Conclusion

In this paper, we presents a case study for mapping test data need for the integration testing in Norwegian public sector. Through this study, we conclude that a synthetic and dynamic test population that is statistically representative to the real population is welcome in this context, and find that a search function is necessary to make such test data usable. We also find conflict of interest in the test data need, and suggest that this could be solved either by change of test

strategy in the pertinent organizations, or by building extra technical solutions.

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