AT OSBORNE

Urban Matters,
People Matter

Understanding the effect of the increase in the intellectual disability population: A System Dynamics approach

Robyn van Houdenhoven

AT OSBORNE

TU Delft

Understanding the effect of the increase in the intellectual disability population

A System Dynamics approach

Master thesis submitted to Delft University of Technology

in partial fulfilment of the requirements for the degree of

MASTER OF SCIENCE

in **Engineering and Policy Analysis**

Faculty of Technology, Policy and Management

by

Robyn van Houdenhoven

Student number: 4646355

To be defended in public on April 11, 2023

Graduation committee

Chairperson	: Dr. A.M.G. Zuiderwijk- van Eijk, TU Delft
First Supervisor	: Dr. S. Hinrichs-Krapels, TU Delft
Second Supervisor	: Dr. ir. F.M. Floortje d'Hont, TU Delft
External Supervisor	: M van Rooijen, AT Osborne
External Supervisor	: M. Apperloo, AT Osborne

Preface

In front of you lies the master thesis "Understanding the effect of the increase in the intellectual disability population: A System Dynamics approach". This thesis was written as the final graduation criterion for the master of Engineering and Policy Analysis at the TU Delft from September 2022 to April 2023.

The process of this research over the past few months at AT Osborne has been a great opportunity. I gained new knowledge regarding the intellectual disability sector in the Netherlands. A sector with which I was not familiar yet. Furthermore, I was able to combine the new knowledge with methods I learned during my studies. My biggest fulfilment came from testing my modelling skills while creating my own system dynamics model.

Without the assistance of my graduation committee, this project would not have been possible. First, my supervisors from the TU Delft. Saba Hinrichs-Krapels, Anneke Zuiderwijk- van Eijk, and Floortje d'Hont. A special thanks to Floortje who joined my graduation committee halfway and had to guide me with the development of my model within a very short amount of time. Next, I also want to thank my supervisors from AT Osborne, Michel van Rooijen and Marieke Apperloo, who helped me understand the intellectual disability sector and showed me how it is to be a consultant. In addition, I also want to express my thanks to the other people from the Strategy and Finance team at AT Osborne, who were always very eager to help me and share their thoughts about my research. A special thanks to Elske Visser, who helped me during the data search.

Furthermore, I want to express a special gratitude to my partner, family and friends, who stood by me during the process and were a wonderful support system when I was struggling with the research. Especially to the ones who read parts of my research to help me improve the quality and readability of the thesis.

As a final note, I hope you enjoy reading my thesis. My time as a student is over, and I am grateful for all the experiences I had during my student life.

R.M.C. van Houdenhoven
Delft, April 2023

Executive summary

The intellectual disability population increased from 65.545 people in 2011 to 116.200 people in 2020. In other words, the population almost doubled in less than ten years' time. Interventions are required to be able to make sure everyone receives the needed care. Therefore, the causes for the growth should be further examined before any decision on intervention can be taken. This thesis contributed to understanding the factors influencing the increase in the intellectual disability population and evaluating the behaviour of the sector. To improve the understanding, a System Dynamics model was designed. The main research question designed for this thesis is:

"Why is there an increase in demand within the intellectual disability sector in the Netherlands?"

The population with an intellectual disability goes through four phases, from the existence of the disability to the emergence of the demand for care, to the application for care to the sector, ending in the preparation of a specific care plan. Since this research examines the growth in the intellectual disability population itself, the focus is on the first three stages. Based on these stages the study is structured and three phases were gone through. First, a literature review was conducted to identify factors affecting the population with intellectual disabilities. After the literature review, self-reliance and healthcare sector institutional changes were identified as important.

The second phase was a data analysis, which identified trends in the intellectual disability sector, based on available data about the intellectual disability sector from the CBS and CIZ. It was found the data showed more or less the same results for the different care profiles. Care profiles represent the different degrees and intensity of care and support to which someone with an intellectual disability is assigned. The inflow, the number of new indications for a specific care profile, is relatively stable after an outlier caused by the system change in the Netherlands. The outflow, the number of deceased people, was roughly the same over the year, even though the total population increased. These two findings ruled out epidemiological factors and the increase in life expectancy as being a key cause for the growth of the intellectual disability population. Which was in line with the findings from the literature review.

The third phase of the study was combining the knowledge gained from the literature and data phase into the modelling phase. The modelling phase consists of constructing a conceptual model and developing the System Dynamic model. The conceptual model was developed including all the interconnected relations between the identified factors. In the conceptual model, three reinforcing feedback loops were found around self-reliance. Self-reliance is the possibility of people performing their own tasks individually, based on different aspects of life. For the intellectual disability population, being self-reliant indicates that they do not seek help from the healthcare sector, but can provide the care themselves, or by someone from their network. One of the reinforcing feedback loops indicates that the smaller the social network, the less ability to ask a social contact for help, and the less self-reliant. When self-reliance is lower, there are fewer opportunities to attend social events and meet new people., which leads to an even smaller social network. This is a vicious circle, with a lot of negative consequences for the intellectual disability sector. The same vicious circles can appear for the other two variables influencing self-reliance, the ability to attend a regular school and being employed or not.

For a more detailed understanding of the relationship between self-reliance and the intellectual disability population, a quantitative System Dynamics model was built. Three different subsystems were created. The first one modelled the population. The population was subdivided into three different IQ groups, IQ score below 50, IQ score between 50 and 70, and IQ score between 70 and 85. The second sub-model was the self-reliance model. The factors that influence self-reliance, the social network, ability to attend a regular school and whether or not someone is employed, were put into this sub-model to analyse the changes in self-reliance. The third sub-model was the indication sub-model, which analysed the number of people applying for care, leading to the number of indications for the intellectual disability sector. The number of indications equals the number of people for which the intellectual disability sector should provide care. Multiple assumptions were made to be able to give value to the changes in self-reliance

The quantified System Dynamics model gave better insights into the relationship between self-reliance and the intellectual disability sector. when there is no intervention, the self-reliance of the intellectual disability population continuously decreases, resulting in more people applying for care from the Wlz. This vicious circle could not be rejected in the quantified model, and therefore it can be concluded self-reliance does influence the intellectual disability sector.

Especially for adults and the population with an IQ score between 70 and 85, losing a job can have negative consequences. More people will then apply for care from, the Wlz, which would become unmanageable for the sector.

Although the model is suitable for obtaining more insights into the growth of the intellectual disability population, partly caused by a decrease in self-reliance, the model outcomes could not give numerical outcomes. The reason for this is that not all assumptions could be validated. For future research, it would be recommended to improve the assumptions to be able to get more insights into how possible policy interventions could influence the sector. The assumptions could, for example, be improved by expert interviews. Possible policy interventions to consider could be regarding the employment of the intellectual disability population. For this part of the population, simple voluntary jobs, or other social initiatives could be enough to make sure they do not fall back on the healthcare system. However, before grounded advice can be given, these policy interventions should first be evaluated for possible drawbacks or unintended consequences.

Using System Dynamics in the complex world of healthcare is done rarely and typically focuses on the distribution of resources and facilities. This study was the first in trying to capture the long-term effects of losing self-reliance in the intellectual disability sector. Because there are 2.2 million people with an IQ score between 70 and 85, the importance of further studying the possibility of them living a relatively normal life should continue, with this model as a starting point.

Contents

List of Figures

List of Tables

List of Abbreviations

Abbreviation	Definition
Wlz	Long-Term Care Act
VG	Verstandelijk gehandicapt (Dutch abbreviation for intellectual disability)
CIZ	Care Needs Assessment Centre
KPI	Key performance indicator

1 Introduction

In 2020, 116.200 people in the Netherlands had an indication of an intellectual disability. An indication entitles someone to receive care from a specific healthcare sector, in this case, the intellectual disability sector. Someone with intellectual disability experiences limitations in both intellectual and adaptive functioning, and needs constant care and support (Kaldenbach, 2015). In 2011, only 65.545 people had an intellectual disability indication (Gommans & Offringa, 2022; Ministry of Health, Welfare and Sport, 2017). In other words, the intellectual disability sector needs to provide care for double the amount of people. The increase in the intellectual disability population is not expected to slow down in the near future, leading to an even greater pressure on the sector which could become unmanageable in the future (VGN, 2017). To make sure the sector is able to cope with the growing intellectual disability sector, the sector needs to be adjusted.

1.1 Knowledge gap

As previously stated, the number of people with an intellectual disability has almost doubled since 2011 (Gommans & Offringa, 2022; Ministry of Health, Welfare and Sport, 2017). At this point, twice as many people are receiving an indication for an intellectual disability, the inflow, then there are people dying, the outflow. It is not expected this will change in the future. The first reason for the large inflow and small outflow is the ageing of the population. Ageing will cause an increase in life expectancy, leading to a decrease in outflow (Marian Maaskant, 2018). Due to the extended life expectancy, people will also cope with additional chronic conditions, which makes it even harder to provide care (Gommans & Offringa, 2022). Together with a constant inflow, the total care demand of people with an intellectual disability will rise. Secondly, the redesign of the intellectual disability sector in 2015 changed the number of people allowed to receive an indication. In the Netherlands, the care and support for the intellectual disability sector are covered by the Long-term care Act (from now on: Wlz). The Wlz consists of multiple care profiles, VG1 until VG8. These care profiles imply the quantity and intensity of the needed care. Generally, it is assumed that the higher the number of the care profile, the more care is needed. A third reason for the large inflow in the intellectual disability sector is an increase in the number of people with a non-Western background applying for care (Gommans & Offringa, 2022). The increase of non-Western people is partly caused by immigration, but also because those people did not (always) apply for care from the healthcare system in the past due to cultural backgrounds.

Next to the increase in the intellectual disability population, society is also changing (Staalduinen & Voorde, 2011). An increasing movement arises where it is preferred to let people live at home as long as possible which makes the intellectual disability population more dependent on their relatives (Brennan et al., 2020). Moreover, society is becoming more complex and demanding. The intellectual disability population cannot meet these demands, making them even more distant from the general population. Ultimately, this could lead to more people applying for care. However, the exact impact is hard to predict. Research from Brennan, Murphy, McCallion, and McCarron (2017) also emphasizes that society and the way care is provided to people with an intellectual disability is changing and the quality should be guaranteed. Most research about the intellectual disability sector concludes with future research opportunities to improve the sector to cope with the growing population. None of them seem to have found the main reason for the increase.

1.2 Research questions

Regarding the increase in the intellectual disability population, some causes were already named in the section above. However, this first literature exploratory should be expanded to check whether all the factors influencing the intellectual disability population are found. Therefore, this research first focused on finding the factors that increase the intellectual disability population. Once these factors are identified, they will be evaluated based on the trends, connections and behaviour. This helps the intellectual disability sector and their abilities to make changes.

The main research question of this study is as follows:

"Why is there an increase in demand within the intellectual disability sector in the Netherlands?"

The following sub-questions have been made, to help answer the main research question.

1. What are the factors causing an increase in care demand in the intellectual disability sector?
2. What were the historical trends in the care demand in the intellectual disability sector in the Netherlands?
3. How are the factors influencing the intellectual disability population connected in the Netherlands?
4. How do the interconnected factors influence the behaviour of the intellectual disability sector in the Netherlands?

The first sub-question focuses on the factors that influence the care demand in the intellectual disability sector globally. These factors were searched for in the literature. The second sub-questions dived into the changes in the intellectual disability sector in the Netherlands over the years seen in the data. The third sub-questions is answered by constructing a conceptual model of the relationships between the identified factors. The fourth sub-question is answered by developing a simulation model, specifically a System Dynamics model, to analyse the influence of the factors on the care demand of the intellectual disability sector. The choice for the different methods is further explained in chapter 3.

1.3 Structure of the report

In the next Chapter, Chapter 2, background information about the intellectual disability population is provided. An explanation of the used methods for this research will be explained in Chapter 3 . Chapter 4, explains the results from the literature review, based on the different stages of the intellectual disability process. After that, the historical trends were explored in the data, in chapter 5. Next the factors and trends are translated into a model. In chapter 6 the conceptualization, formulation and validation of the System Dynamic model is elaborated on. Continuing with the outcomes of the System Dynamics model in Chapter 7. Finalising the research with a discussion of the results in Chapter 8 and the answers to the research questions in Chapter 9.

2 Background on the intellectual disability population

In this Chapter, the different stages someone with an intellectual disability goes through are explained. Figure 1 shows an overview of the four stages. Based on several exploratory meetings with experts from AT Osborne, the four stages were identified. During these exploratory meetings, different aspects of the intellectual disability population and sector were discussed. These aspects were 'translated' into these four stages. In the literature review, they were evaluated based on applicability to the intellectual disability population in the Netherlands and validation by literature. The focus of this research is to find and evaluate the factors influencing the intellectual disability population. Since the fourth stage is about how and where the care is provided, this does not affect the size of the population. Therefore, the fourth step was excluded from this study. However, to get a complete overview of the intellectual disability population, this stage is visualised and further described in Appendix B.

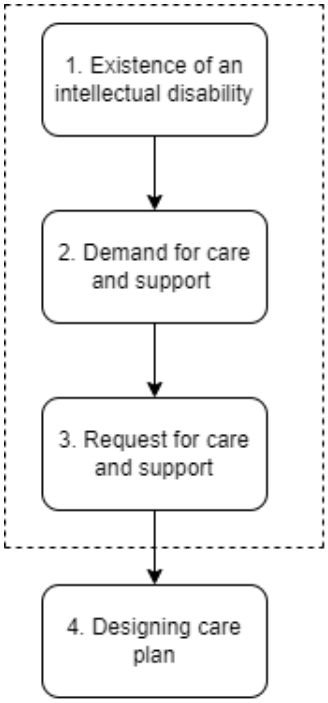


Figure 1: Stages intellectual disability population

2.1 Stage 1: Existence of an intellectual disability

First, it must be established whether there is an intellectual disability. Someone with an intellectual disability experiences limitations in both intellectual and adaptive functioning (Kaldenbach, 2015; GGZStandards, 2018; American Psychiatric Association, n.d.). Intellectual functioning relates to intelligence, and is measured in IQ score. When the IQ score is 75 or lower, with a valid intelligence test, someone is able to receive an indication for the intellectual disability sector in the Netherlands (National Health Care Institute, n.d.-a). Compared to other countries, this is a slightly higher score. The Netherlands chose this different IQ threshold because even people with an IQ score of just over 75 may need care and demand in their daily lives. Therefore, when assessing whether someone has an intellectual disability, adaptive functioning for everyday functions is also considered. In short, the severity of disability and social, practical and conceptual limitations are combined to determine whether a someone receives an indication. This already highlights the personal approach the application process is.

In most cases, an intellectual disability arises early in life. It is a congenital and incurable disability caused by, for example, a defect during pregnancy, oxygen deficiency during birth, or a genetic defect (DisabledNL, n.d.-a). The diagnosis of intellectual disability is shortly after birth or in the first months/years of life. However, this does not automatically mean that from the moment of diagnosis, care is needed and provided by the intellectual disability sector. When and how much care is needed depends on different factors, amongst which is the severity of the disability. Another cause for an intellectual disability is a syndrome or disorder, best-known is Down syndrome (DisabledNL, n.d.-b). Not the whole intellectual disability population is born with this syndrome. It is also possible to get an intellectual disability from meningitis, another disease, or a major accident later in life. However, the vast majority has a intellectual disability early in life.

2.2 Stage 2: Demand for care

There are different gradations of intellectual disability, from light, moderate, severe to very severe (Prinsen Stichting, n.d.; Care House, n.d.), shown in Table 1. The severity of the disability is a good indicator for the care needs. Next to this, the specific care needed varies also per individual. Therefore, the intellectual disability sectors has to be flexible in providing care. The more severe the disability, the more care and support are needed. Most of the intellectual disability population are not capable to live independently, travel, work, communicate, do their (personal) hygiene, and take responsible decisions about their financial and legal affairs (Goed vertegenwoordigd, n.d.). The ability of people to perform these tasks can be measured in self-reliance (Woittiez, Egging, & Ras, 2019). The more self-reliant someone with an intellectual disability is, the less care and support are needed from the sector.

Table 1: Different forms an of intellectual disability (Prinsen Stichting, n.d; Care House, n.d.)

Severity of intellectual disability	**IQ score**	**Percentage of intellectual disability population**	**Explanation of group**
Light intellectual disability	50 – 75	75%	This group can manage 'simple' jobs, and join activities, but need support with complex daily tasks, and health choices. Communication is also difficult for this group.
Moderate intellectual disability	35 – 50	18%	Mostly the same abilities and difficulties as someone with a light intellectual disability. The difference is that more time is needed to perform the tasks.
Severe intellectual disability	20 – 35	7%	All individual tasks are difficult or impossible to perform, extended care and support are needed. Communication with this population is done with verbal language.
Very severe intellectual disability	<20	1%	This group is always dependent on others and can only communicate non-verbally.

2.3 Stage 3: Request for care and support

In the Netherlands, care for the intellectual disability population is covered by the Long-Term Care Act (from now on Wlz). The Wlz provides nearby care and support 24 hours a day, all days of the week for the rest of their lives (CIZ, n.d.-b). Next to the intellectual disability sector, the Wlz also covers other healthcare departments which provide long-term care, like the physical disability sector. In 2017, 12% of the Wlz application was for an intellectual disability indication. The indication is granted by the Center for Indicative Care (from now on CIZ). CIZ is an independent organisation which determines per individual which kind of care someone is allowed to receive, based on the different care profiles.

To enter the Wlz, a total of five steps have to be taken by the client and the CIZ, visualized in Figure 2 (CIZ, n.d.-a). On average, six weeks elapse between the application and the granting of the indication.

1. A comprehensive form needs to be filled in containing personal details, the severity of the disability, the care needs, and all the medical documents (CIZ, n.d.-c). Care needs cover anything you need help with in daily life and possibly also care for additional diseases/disorders. The form is mostly filled out by an authorized person or a specific physician. This form is handed to the CIZ.

2. The care situation included mapping all the care needs, including possible other diseases. This is different from step one because this step is carried out by the CIZ.

3. A valid IQ score is obligatory to obtain an indication. If a valid IQ score is not yet known, an IQ test should be taken by the applicant. As mentioned before, the norm score of IQ must be below 75 to qualify for care in the intellectual disability sector.

4. One of the criterion for entering the Wlz is the need for indefinite, permanent care. This is evaluated and determined within this step by the CIZ.

5. A specific indication for the care profile is determined within this step. In the Netherlands, the intellectual disability sector contains 6 care profiles, from

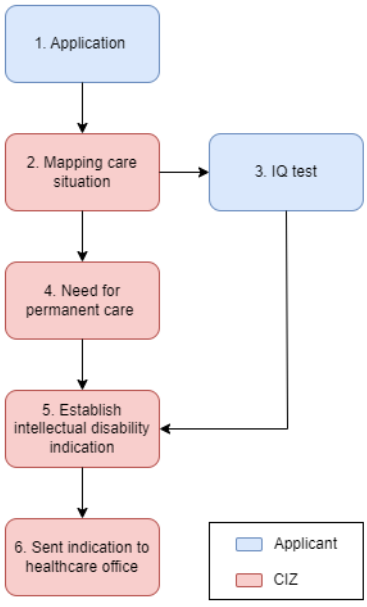


Figure 2: Intellectual disability indication application process (CIZ, n.d.-c)

VG3 to VG8 (VG is the Dutch abbreviation for intellectual disability), see Table 2 (Ministry of Health, Welfare and Sport, n.d.-i; CIZ, 2020). More detail about the different care profiles can be found in Appendix A.

6. The indication will be verbally explained to the applicant. Simultaneously, the indication is sent to the corresponding healthcare office. The healthcare office helps design the care, which is covered in stage 4 (see Appendix B).

Not all applications for an intellectual disability indication are approved, on average 13% is rejected (Netherlands Court of Audit, 2018). Compared to the other sectors that can apply for a Wlz indication this is relatively low. It is possible the care needs of someone with an intellectual disability change over time. Then the indication can be re-evaluated by the CIZ and possibly changed, including revising and altering the care plan (CIZ, n.d.-c).

Table 2: Care Profiles and number of indications in the Netherlands in 2020 (CIZ, 2023)

Care profile	**Explanation**	**Indications in 2020**
VG3	Living with assistance and care	25.495
VG4	Living with assistance and intensive care	17.195
VG5	Living with intensive assistance and intensive care. Additional care possible	14.040
VG6	Living with intensive assistance, care and behavioural regulation	27.270
VG7	(closed) Living with very intensive assistance, care and behavioural regulation. Additional care possible	15.740
VG8	Living with assistance and complete care and nursing. Additional care possible	8.485

3 Research methods

This chapter details the methods used for this study. To answer the research questions, three different phases are carried out, each with its own method. Starting with a literature review, then data analysis, and finally modelling. In figure 3, the research flow diagram is visualized. This diagram shows the different chapters of this research, including which methods are used where and which sub-question will be answered. For a complete overview, the main research question and sub-questions will be repeated.

Main research questions: "Why is there an increase in demand within the intellectual disability sector in the Netherlands?"
Sub-questions:

1. What are the factors causing an increase in care demand in the intellectual disability sector?
2. What were the historical trends in the care demand in the intellectual disability sector in the Netherlands?
3. How are the factors influencing the intellectual disability population connected in the Netherlands?
4. How do the interconnected factors influence the behaviour of the intellectual disability sector in the Netherlands?

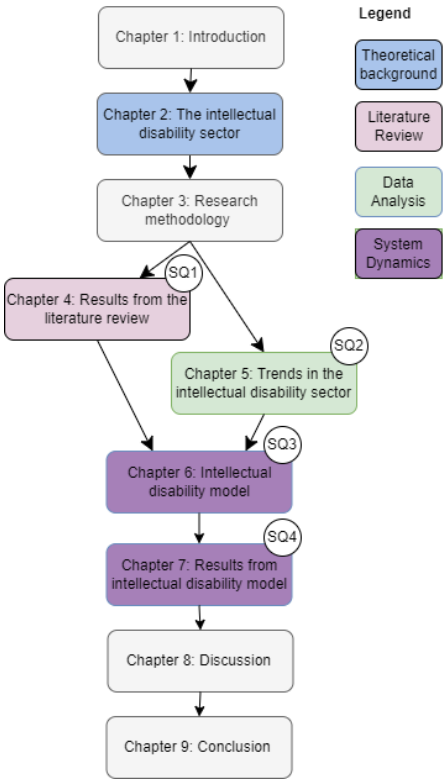


Figure 3: Research Flow Diagram

3.1 Literature review

To answer the first sub-question, a literature review was performed to analyse the factors influencing the care demand in the intellectual disability sector per stage. The aim of this literature review was to identify the key factors. Based on this aim and the sub-question, several key concept were determined to find the appropriate literature. The literature review was performed in a structured and thorough manner. The search engines that are used are Scopus, PubMed and Google Scholar. These are well-known databases and formed a good overview of the available literature.

The most important key concept to consider is the *intellectual disability sector*, or the *intellectual disability* itself. It needs to be proven the found factors really influence this sector and not the general healthcare sector. Since there was searched based on the different stages identified in chapter 2, different kinds of concepts were used in different combinations. For the first stage, the existence of an intellectual disability, it was important to consider the *prevalence* and *incidence*. In the second stage, the rise of the demand for care, key concepts like *care demand* and *trends* were used. In the third stage, the request for care, there was searched for factors influencing whether or not someone applies for care. Since each country has its own healthcare system, it must be taken into account that some factors affect a specific sector. To identify which factors affect the Netherlands, the healthcare systems of the countries under study must be similar. Most healthcare systems similar to the Netherlands are high-income countries. It was therefore decided to add *high-income* and *high-income countries* to the search query.

The identified core concepts were put together in a search query. The search query that was used for this literature review was: "intellectual disability"[Title/Abstract] OR "intellectual disability sector"[Title/Abstract] AND ("prevalence"[Title/Abstract] OR "trends"[Title/Abstract] OR "incidence" [Title/Abstract]) AND ("high-income countries"[All Fields] OR "high-income"[All Fields]). After using these search queries 13 scientific papers were found on PubMed and 28 on Scopus. These papers were the start of the literature review. Since different factors were found, more specific literature was search on about this factors during a targeted search.

During the literature search, global as well as national literature was used. Global literature was used to find out the important relationship between certain factors and the care demand of the intellectual disability sector. After that, these

factors were searched for in Dutch literature to figure out the influence of these factors in the Netherlands. Used Dutch literature came from governmental reports, policy papers, and internal research from public institutions like TNO or Zorginstituut Nederland, so-called *grey literature*.

To categorise the factors and be able to specify different types of factors, the DESTEP method was used. In this method, six different forces are considered; demographic, economic, social-cultural, technological, ecological, and political-legal forces (Benders & Merkus, 2020; Eelants, n.d.). The literature review was structured based on these forces. Demographic forces are about the population, mainly in terms of size, place, age, gender, profession, etc. Economic forces are about the economic status of a country, in this case, the Netherlands. For this force, factors like income, unemployment, inflation, etc. are important. The social-cultural factors are about society with all its different beliefs and values. Religion is also an important factor in this process. For the technological forces, the focus is on technological developments and innovations. An increasingly more important force is the ecological force, which considers the climate. The last force is the political-legal force, where the influence of the government on the macro-environment is considered (Benders & Merkus, 2020; Eelants, n.d.).

3.2 Data collection and Analysis

To answer the second sub-question, data analysis was performed. The data analysis gave insights into the trends in the intellectual disability sector in the Netherlands. Three steps were taken to perform the data analysis. First, the data search and collection was done. After the data was found, the data was cleaned and combined. Lastly, the trends had to be found in the data. For the data analysis, Jupiter Notebook from Anaconda Navigator 2.1.4 was used. Python is a computer programming language that can be used to conduct data analysis. The advantage of Python is that all the steps can be performed in Python.

During the data search and collection, a lot of different open databases have been searched, such as MLZ Statline (CBS), CIZ, CaK, and other smaller databases. First, the search for data was focused mainly on factors found during sub-question 1. Unfortunately, no specific data on the factors was found. But after that, other important data about the trends of the different care profiles was found and also used for the analysis. The data that was used, came from CBS and CIZ. These two institutions have openly available data about the intellectual disability sector. CBS has a lot of general data about the intellectual disability population. CIZ contains some more data about the intellectual disability sector since they are also the organization which reviews the Wlz applications. Therefore it was decided to focus on the found data. The data collected were collected from the year 2015 from CBS and CIZ. The reason for this is the system change that happened that year. To be able to compare the data from before and after the system change, additional knowledge is needed, which was outside the scope. So, the starting year was 2015.

After the data was collected, it had to be cleaned and combined. The data cleaning was performed by looking for missing and strange outlier values. One cleaning step that was takes was some the missing values or use of signs. For the CBS data, there was missing data for the data points that had a 0 as a value. These values have been replaced with the value zero. In the CIZ data set, <10 was used in some of the data values. There was found that the <10 values, had a missing value in the CBS data. Therefore there is decided to replace the <10 with 0. After the data is cleaned, the data sets need to be formatted in the same way to combine the data sets. There was chosen to use the CBS data (CBS, 2021b) as the main data set and supplemented that with CIZ data (CIZ, 2023). The CBS data set contained data about the different developments in care profiles about regions, inflow, outflow and transit of the Wlz between 2015 and 2020. The CBS data goes up to 2020 and was supplemented with CIZ data from 2021 and 2022. Unfortunately, these additional two years were only possible for the total number of indications per care profile data, and not for the data about the inflow, outflow, deceased, and transfer data.

Lastly, the data analysis could start. During the data analysis, the different care profiles were analysed based on the different topics found in the data sets. This resulted in trends of the different care profiles in the intellectual disability sector over the years. The trends analysed were based on different topics like inflow, outflow, transfers between care profiles, etc.

3.3 Simulation model

To answer the third sub-question, a simulation model was developed, more specifically a System Dynamics model. System Dynamics models analyse the dynamic behaviour of complex systems. As discussed before, due the intellectual disability sector is a complex sector. The key factors and trends found during the first two sub-questions are used to develop the model. The model can be validated by checking if the past trends are visible when running the model. During the validation process, knowledge can be gained about the behaviour and influence of the key factors on the model.

System dynamics is a method developed by Forrester (1995). An SD model is a computer simulation modelling technique to develop a simplified representation of the real-world system (Sterman, 2001), in this case, the intellectual disability sector. The model is structured based on stocks and flows, which are formed by differential/integral equations. A stock is the sum of its inflows minus its outflows over time, starting with an initial value. These flows can be influenced by other variables in the model which cause the stock's value to change over time. Important elements of an System Dynamics model consist of feedback loops, accumulations and delays. Since the intellectual disability sector is also influenced by social and physical components, a System Dynamics approach offers opportunities to look at these components and the mechanisms in which they appear.

The development of an System Dynamics model consists of multiple steps (Martinez & Richardson, 2011). First, the problem needs to be identified. This identification has already been partly done in the introduction but is further specified based on the literature review and the data analysis. After the literature review and trend analysis, more is known about the influence of different factors on care demand in the intellectual disability sector. So, the problem identification needs to be conceptualized. This step was used to decide on the system boundaries, and the major mechanisms of the system, including the feedback loops and the dynamic hypothesis. These major mechanisms can be conceptualized in different diagrams, causal loop diagrams, stock-flow diagrams, or sub-system diagrams. The dynamics hypothesis describes how the problem occurring in the system will be described. After the model is conceptualized, the model was formulated. This means translating the conceptual model into a quantitative representation, including all the loops and delays from the conceptualization. As mentioned before, the factors and trends from the previous two sub-questions were used during the development. This gave a good start in building the model, but some additional data needed to be gathered to complete the model. For the lacking data, assumptions were made and validated during the validation step.

The starting point for the System Dynamics model of the intellectual disability sector was the population model. It is important to implement the trends in population growth and the influence of that on the number of indications in the intellectual disability sector. To evaluate the behaviour of the intellectual disability system and how many people apply for care, the influence of self-reliance is implemented. Within the determination of self-reliance, several reinforcing feedback loops were visible. For example, the less self-reliant the population is, the smaller the social network is. Which then again lead to an even smaller level of self-reliance. As a consequence a vicious circle appears and the intellectual disability population increases even more. Not only feedback loops were visible in the intellectual disability system, but also delays were present. For example, once someone has applied for care, the application process will start. The application process can take up to 6 weeks.

Once this model is developed, it needs to be verified and validated before the model can run. This means no more errors can occur and the model fits the purpose of the research. This step consists of multiple analyses to test model structure and tests of model behaviour. For this research, the process stops here. If decided to carry on the research, a policy analysis can also be performed to test multiple policy interventions. The goal of this research was to get a clear understanding of the influence of the key factor(s) on the intellectual disability sector.

4 Results from literature review

In this chapter, the results from the literature review were discussed. Based on the literature review, an answer to the first sub-question is formulated: *'What are the factors causing an increase in care demand in the intellectual disability sector?'* In Chapter 2, Figure 1, four stages were identified for the intellectual disability population. The focus of this research is to identify the reasons for the growth of intellectual disability. A change in the size of the population is caused directly or indirectly by the first three stages. The fourth stage focuses on the care the intellectual disability chooses and not on a change in the population. Therefore, the fourth stage was excluded from this research. The found factors are discussed per stage.

After all the factors are identified, the most important factor(s) must be determined. To decide on these key factors, different criteria were used to evaluate the found factors. First, it was important that the factors were found significant within the literature, meaning that it has to be proven that the factor has an influence on the increase in care demand. The second criterion is that the factors is found to have an influence in the Netherlands. Since the literature review is focusing on global as well as national literature, this should be evaluated. Lastly, it should be possible to interfere with the factor, meaning that something can be implemented to better understand which factors influence the care demand in the intellectual disability sector.

4.1 Factors affecting stage 1: Existence of an intellectual disability

The first stage was about how people get an intellectual disability. This means that it is dependent on the cause of intellectual disability. Considering all the different categories from the DESTEP analysis, not a lot of different forces influence this stage. Demographic forces are important, specifically, epidemiological factors and life expectancy of the population, are influencing the care demand.

4.1.1 Epidemiological factor

As mentioned in paragraph 2.1, there are different causes for an intellectual disability. Most people are born with an intellectual disability. In this stage, the care demand is the total number of people who have an indication of an intellectual disability, whether they receive care or not. According to Staalduinen and Voorde (2011), the incidence of an intellectual disability, the number of new people with an intellectual disability, is changing due to technological improvement. With technological changes in prenatal screening and hereditary education, the number of people born with an intellectual disability decreases. An increase in prenatal testing does not automatically mean that the number of children born with an intellectual disability will be minimized. There is also a percentage of women that do not want to have prenatal tests because of potential risks for the fetus, or because they want to have the baby without any information before birth (Kuppermann, Nakagawa, Cohen, Dominguez-Pareto, & dn Susan D. Holloway, 2011). Other women do choose to do prenatal tests, just to have information about the health of the baby before it is born to be prepared (Acharya, 2012). Prenatal tests for an intellectual disability are not obligatory, so it will difficult to measure the exact impact of prenatal screening.

On the other hand, the incidence of an intellectual disability is also increasing due to the age of women when giving birth. The age at which women have children has already increased since the seventies (CBS, 2021a). The older a woman is when having a child, the higher the chance of a baby with an intellectual disability (DisabledNL, n.d.-a). Together, this actually increases the number of children born with an intellectual disability. Therefore, it will be difficult to draw a hard conclusion on the exact change in incidence in the intellectual disability population.

These same conclusions were drawn by Ras, Woittiez, Kempen, and Sadiraj (2010). They also found that the incidence of intellectual disability can raise a little with the increase of cousin marriages, which is quite common among Turkish and Moroccan families. In 2010, it is estimated that an average of 25% of the Dutch Turkish and Moroccan people were in such a cousin marriage. When such couples have a child, the likelihood of the child having a disability is twice as big. However, there is a lot of uncertainty about how this will evolve in the future.

4.1.2 Life expectancy

An increase in life expectancy, in other words ageing, is an important factor for the increase in care demand for this stage. The total intellectual disability population will stay larger because people will grow older. This is a well-known phenomenon, visible not only in the intellectual disability population but also in the general population (Lin, Lin, & Hsu, 2016; Doody, Markey, & Doody, 2012). Improved medical knowledge and skills, care and treatment are the main reasons for the extended life expectancy (Evenhuis, 2011; Biezen et al., 2022). People with an intellectual disability follow the same trend as the general population (Staalduinen & Voorde, 2011). From 2015 to 2020, there was an increase of 21% in the number of people with intellectual disabilities who were 60 years and older in the Netherlands (Gommans & Offringa, 2022). It was found that the average age of mortality is 63 years in 2020 for the intellectual disability population. But at the same time, the number of people with a disability above the age of 70 is also increasing. This means that the outflow will be smaller while the inflow will be more or less stable, which will lead to an increase in the total intellectual disability population.

In Spain, research was conducted about the quality of the extra years of the life of the intellectual disability population (García-Domínguez, Navas, Ángel Verdugo, & Arias, 2020). The prevalence of additional diseases, occurring due to the increased life expectancy, is compared between intellectual disability and the general population. They found that the intellectual disability population is more vulnerable to health problems. However, when these health problems can be detected and intervened earlier, a lot of health problems can be minimized or even avoided. Because at this point, detection and treatment of the intellectually disabled population are not the same as in the general population. García-Domínguez et al. also suggests that more research is needed to develop better treatment plans for the intellectual disability population, which would include a better understanding of the impact of diseases.

4.2 Factors affecting stage 2: Demand for care

The care demand of the intellectual disability population is considered during the second stage, as explained in Section 2.2. The care demand indicates the amount of care and assistance someone with an intellectual disability needs. Considering the different categories from the DESTEP analysis, it depends on technological forces, more specifically technological improvements and employment, and societal-cultural forces, more specifically self-reliance.

4.2.1 Technological innovations

There are a lot of technological innovations which can improve day-to-day life. Also for the intellectual disability population, technological innovations can bring opportunities (Staalduinen & Voorde, 2011). With the right technologies, it will be easier for someone with intellectual disability to live at home. Advanced technologies can support them during the day and can be programmed specifically for that person. However, this does not work for the whole intellectual disability population. The more severe the intellectual disability, the less able to work with these innovations. And for the intellectual disability population, social contact is also an important element (Biezen et al., 2022). Most of these innovations mean that humans will be replaced by computers/robots. Meaning the important social element will be reduced. So, innovations in the medical field can bring opportunities for part of the intellectual disability, but there are also a lot of downsides sides.

Technological innovations can have negative consequences for the self-reliance of the intellectual disability sector. Due to innovations, companies can replace a lot of their 'simple' human machines with robots or automated systems. For companies, this means the work can be done more efficiently. However, those jobs are suited for the intellectual disability population. More consequences of the loss of jobs will be given in paragraph 4.2.2.

4.2.2 Self-reliance

Self-reliance is the possibility of people performing their daily tasks, based on several dimensions of life (Eggink, Woittiez, & Klerk, 2020). Eggink et al. (2020) define three dimensions of self-reliance functional, administrative and social self-reliance. These different dimensions are again specified in multiple factors, as can be seen in Figure 4. Functional self-reliance means someone can care for themselves in terms of personal hygiene and being able to do domestic activities individually. Functional self-reliance also covers someone's mobility and the ability to hear and see. Administrative

self-reliance indicates someone has computer skills to deal with their financial issues and fill out their administrative forms. Lastly, social self-reliance, indicates someone can maintain their social contacts and participate in social events in their spare time.

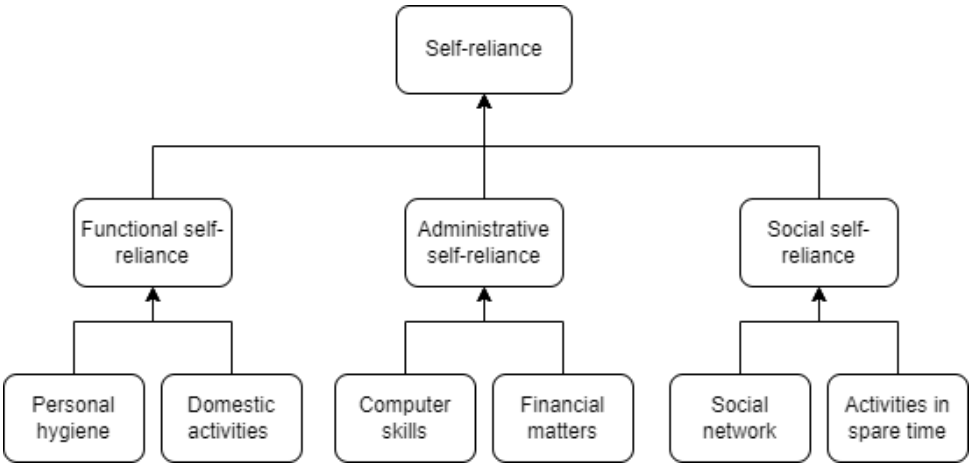


Figure 4: Dimensions of self-reliance (Eggink et al., 2020)

Regarding functional and administrative self-reliance, the intellectual disability population will (mostly) not be able to perform these tasks individually. Part of the intellectual disability population can have a 'simple' job, which provides them with some administrative self-reliance. The main focus is on social self-reliance since informal care is an increasingly important topic.

Social network Social network means the number of social contacts, like family, friends, neighbours, colleagues, etc. Some social contacts are willing and have the ability to help another social contact. For the intellectual disability sector, the social network can be of large influence on the care and support needed by the healthcare sector. The care provided by the social network is called informal care, and this has become more important over the years. Most people with an intellectual disability have a smaller social network than the general population, for example, due to the small lack of social skills, fewer social activities, and fewer opportunities to meet new people (Eggink et al., 2020). The size of the social network is dependent on the attitude of life education and age. For example, someone with a light intellectual disability who went to a regular school will have more people in his or her social network. Someone with an intellectual disability from a family with a low social-economic status, who will probably live in less safe neighbourhoods, will even have a smaller social network (Eggink et al., 2020). The intensity of the relationship within the social network is also important. Someone with intellectual disability who is very close to a family member or neighbour will have a higher chance of receiving some support.

Not only the number of people within the social network is important, but the willingness and ability of a social contract to provide informal care is also important. The willingness of the social network to support someone with an intellectual disability is also decreasing because norms and values in society are changing. Where in the past a lot of care and support was accommodated by, for example, neighbours, and family of the church, people now have a much more individualistic lifestyle (Ras et al., 2010). As a consequence, people with intellectual disabilities, who are dependent on care and support, are relying more on the care system in the Netherlands.

Employment One of the difficulties for the intellectual disability population is employment (Woittiez, Eggink, Putman, & Ras, 2018). Someone with an intellectual disability is not able to carry out the same jobs as the general population (Dowse, 2009). 'Simple' and/or routine jobs are most suited. These jobs will make sure that people with a low IQ score are kept busy during the day, meet people, and earn some money. All these factors make sure people are more self-reliant and will not seek help from the sector if they are self-reliant enough. However, due to technological developments, these jobs will disappear due to automation. Without this job, these people can feel compelled or be forced to be persuaded to seek help (Staalduinen & Voorde, 2011). Most of this care comes from the Wlz. This means the care demand will increase.

In the past, the intellectual disability population had the advantages of a smaller chance of traffic accidents, diseases caused by smoking, obesity, alcohol- and drug use and sexually transmitted diseases (Woittiez et al., 2018). However, the changing society, which relies more on self-reliance and self-control, can make these advantages turn into big risks, especially for the young light intellectual disability group (Staalduinen & Voorde, 2011). Together with the fact that the 'simple' jobs are disappearing which gave them a feeling of inclusion in society, as mentioned in 4.2.1 (Biezen et al., 2022). There is an increased chance of loneliness, which causes a vulnerability for this group with the consequence of a higher chance of addiction problems, sexual behaviour, and criminality (Ministry of Health, Welfare and Sport, 2017; Ras et al., 2010; Staalduinen & Voorde, 2011). Targeted guidance is needed to make sure the young intellectual disability population will not fall into this bad environment. The consequence is that, where in the past they could lead a 'relatively ' normal life, with a simple job and some guidance mostly provided by a relative, they now fully rely on the healthcare system (Ras et al., 2010).

4.3 Factors affecting stage 3: request for care and support

The third stage is about the number of applications for Wlz care, meaning the care demand for this stage will be the number of people with an intellectual disability indication. Considering all the different categories from the DESTEP analysis, this will be dependent on demographic factors, more specifically multi-morbidity, migration, and political factors, specifically institutional changes.

4.3.1 Demographic factors

Multi-morbidity Multi-morbidity means the presence of two or more long-term diseases. For those intellectual disability, this means that they are coping with an additional disease. It is generally known that when people are ageing, the prevalence of diseases will increase. These additional diseases, someone can be coping with, will also be evaluated during the application process for a Wlz indication (CIZ, n.d.-c). It is also possible to re-evaluate someone's care situation when someone with an intellectual disability will get an additional disease.

The difference between the general population and the intellectual disability sector is that these additional diseases occur earlier and more often in the life of someone with an intellectual disability (Lin et al., 2016; Liao, Vajdic, Trollor, & Reppermund, 2021). Leading to an increase in care needs (Leeuw et al., 2022). In the Netherlands, the vulnerability of the 50 years and older intellectual disability population can be compared to the 75 years old people living in a nursing home (Hoekstra, Bakker, & Ven, 2018). Liao et al. (2021) state that the more is known about the combination of an intellectual disability in combination with an additional condition, the better the population can be treated and supported during their extra years of life. Some of these physical conditions will be further elaborated.

Approximately one in five people with an intellectual disability have epilepsy. According to Robertson, Hatton, Emerson, and Baines (2015) this prevalence is even higher with a more severe intellectual disability or when the client has Down Syndrome (DS). Diagnoses and treatment of epilepsy in the intellectual disability population is (often) difficult, which leads to a higher mortality rate. People with intellectual disability and epilepsy also have a higher chance of fractures, caused by injuries during a seizure or reduced mobility. Research from Marriott and Robertson (2014) suggests that multiple adjustments are possible to improve the care for the intellectual disability population with epilepsy. However, these adjustments have not been implemented yet.

Since 2000, research has been conducted about the presence of dementia among the intellectual disability population. The prevalence increases with age and is even higher when someone also has down syndrome (Strydom et al., 2010; Evenhuis, 2011). Someone with down syndrome can already experience consequences from dementia in their early 40s, while in the general population, most people will experience limitations from dementia in their 70s (McGuire, Whyte, & Hardardottir, 2006; Alzheimercentrum Amsterdam, n.d.). But also in the rest of the intellectual disability population is the chance of dementia two to three times higher compared to the general population (Strydom, Hassiotis, King, & Livingston, 2009). The care and support needs will change when dementia occurs. Caregivers and doctors need to be aware of these changing needs and unique features of dementia for people with intellectual disability to improve diagnoses and care (Sheeha, Ali, & Hassiotis, 2014; Dillane & Doody, 2019). More research is needed for the specific needs of this population and what this care should look like.

Another rising problem amongst the intellectual disability population is obesity, caused by bad nutrition (Krause, Ware, McPherson, Lennox, & O'Callaghan, 2016; De Winter, Bastiaanse, Hilgenkamp, Evenhuis, & Echteld, 2012; Hsieh, Rimmer, & Heller, 2013; Evenhuis, 2011; Staalduinen & Voorde, 2011). Obesity is a problem because most people with intellectual disability do not have enough physical activity or variance in their nutrition. The danger of obesity for the intellectual disability population is that this could lead to cardiovascular problems (De Winter et al., 2012). With more surveillance and anticipatory guidance by the caretakers, obesity could be avoided (Krause et al., 2016). The hard part is that this needs an individualistic approach, which costs a lot of time, effort, and money (Hsieh et al., 2013).

Detection and treatment of additional diseases in the intellectual disability population is harder than in the general population. This statement is proven by Cuypers, Schalk, Boonman, Naaldenberg, and Leusink (2022), where they found that the mortality rate of cancer 1.5 times higher is than the general population, while the prevalence is lower (Evenhuis, 2011). This is because there is too little known about the detection of diseases in the intellectual disability population (Boonman, Cuypers, Leusink, Naaldenberg, & Bloemendal, 2022).

To put briefly, multi-morbidity will be a rising problem in the intellectual disability sector due to an ageing population. This will require a different kind of care and support needs. A consequence of the increase in intellectual disability population and care demand will be the additional costs for the sector (Authority, 2020). Staalduinen and Voorde (2011) suggest collaborating with other sectors to use each other's expertise and knowledge, but also to make it more affordable by distributing the budgets. However, as suggested in most of the papers, more research is needed as to what the exact impact is of ageing and how this changing care demand can be facilitated.

Migration The culture of the non-Western population is more family-centred, meaning that relatives will be cared for, and help from healthcare institutions will be avoided (Ministry of Health, Welfare and Sport, 2017). Next, there was a language barrier which made it hard to figure out how to get guidance. Since the last decade, the amount of people in the Wlz with a migration background is increasing (Staalduinen & Voorde, 2011; Gommans & Offringa, 2022). The reason for this is that successive generations of non-Western families are growing more towards the culture in the Netherlands. For that reason, there is a 'catching up' of the number of people within the Wlz with a non-Western background. This will cause an increased group who need care from the Wlz, and therefore the care demand.

4.3.2 Healthcare sector institutional changes

The intellectual disability sector is regulated by the government in the Netherlands, they set the rules for when and how much care someone is allowed to receive and will finance a large part. These laws and regulations can change over time. This means that someone who is now allowed to receive care, is not when the guidelines are changed, or the other way around. This makes political factors also important to consider. Due to the increasing number of intellectual disability, more money is needed to cover all the costs of this care. Not only more money is needs, also more personell in the intellectual disability sector. The intellectual disability sector now is not able to deal with the increasing population.

In England, Jackson (2017) researched how the political climate influenced the intellectual disability sector over the years. They found that good scientific research led to changes in the legislation which had a very positive effect on the intellectual disability population. After these changes, the learning curve of children and young people with an intellectual disability was known and they could also go to school. Jackson concludes with the statement that new research should be conducted about the future changes in the intellectual disability population in England to prepare to be able to adjust legislation on time to support the population. When the learning curve improves, these children are more able to perform tasks themselves or have a job later in life. This can ultimately make they will rely less on the intellectual disability sector for care and support.

Another factor that is a bit related to the political factor is ageing. At this point, there is not a real connection between elderly care and intellectual disability care, while the ageing intellectual disability population should also need that kind of care (Bigby, 2009). The current intellectual disability institutions are not always able to give the needed care to the ageing population while in an ageing institution, the employees are used to caring for people who are getting older. Despite the fact that the care for older intellectual disability people will be different than the general population, Bigby (2017) thinks it is important that these different sectors, together with the government, should consider combining their forces. New

legislation should be formed about how the care will be provided. This would improve the care provided to the intellectual disability population and will also give clarity about the financing of the ageing intellectual disability population. When part of the care for the ageing intellectual disability population will be covered by the ageing healthcare, this means part of the care demand will be shifted.

As mentioned earlier, the government is deciding whether someone is allowed to receive care. In 2015, there was a big change in the law for the intellectual disability sector. The goal of this system change is to make sure people can live at home as long as possible (National Health Care Institute, n.d.-b). Before 2015, the AWBZ was used to cover all the long-term care. After 2015, this was split into 3 different care acts, among which the Wlz. The Wlz is specifically for people who need permanent care, like the intellectual disability population. For that reason, there is a big increase in 2015 in the number of people in the Wlz, there was a transition period in which people went from the AWBZ to the Wlz. A big system change is not expected any time soon, but small changes are also possible which can cause changes in the number of applications for Wlz, like the IQ score. When this will be partly extended, more people will qualify for care.

4.4 Conclusion factors for the increase in care demand

After evaluating the literature, it becomes clear multiple factors cause the increase in the intellectual disability population. In Figure 5, an overview of the factors that were found within the different stages of the intellectual disability process are shown. After the factors were found, three different categories were identified. First, the population factors indication the intellectual disability population itself is influenced. Second, the social-technical factors which influence the environment of the intellectual disability population. Last, the healthcare sector factors influence the intellectual disability sector. These three categories of factors are important to distinguish because the ability to interfere differs per category. The healthcare sector factors can be influenced in the short-term, by altering policies for example. While the other two categories are only able to be influenced in the long term.

As can be seen in Figure 5, not all the categories have factors for the different stages. The factors were classified based on the found literature. Some of the steps are not influenced by categories, for example, changing something in the healthcare sector does not influence the incidence of intellectual disability. By categorising the factors, a better overview of the found factors was provided, which in the end leads to more specific recommendations.

After classifying the found factors, they were evaluated based on importance. Three criteria were formulated to determine the importance. The first criterion is that the literature considers the factors as influential, based on the studies. Second, the factor needs to be applicable in the Netherlands, which can be proved based on the grey literature. The third criterion is the ability to interfere with the factor. All the main factors are underlined in Figure 5

In the first stage, epidemiological factors and the increase in life expectancy were found to influence the intellectual disability population. Epidemiological factors influence the incidence of an intellectual disability. The increase, caused by the older age at which women have children (CBS, 2021a), and decrease, caused by prenatal testing (Kuppermann et al., 2011; Acharya, 2012), of the incidence of intellectual disabilities, are approximately in equilibrium. Therefore, the epidemiological factor is not considered a key factor for the growth of the intellectual disability population. Life expectancy is the other factor influencing the first stage. Staalduinen and Voorde (2011) found that the increase in life expectancy of the intellectual disability population in the Netherlands is grown from 60 to 63 years old. Considering the size of the increase in the intellectual disability sector, this factor was not considered as a key factor.

For the second stage, there was found that technological innovations, social networks and employment influence the intellectual disability population. Technological innovations bring a lot of opportunities for the intellectual disability population, especially concerning the ability to live at home. However, there are also downsides to these innovations for the population. So, it can be assumed the influence of technological innovations was not the main cause. The overarching factor for the social network and employment influence for this stage was self-reliance. It can be concluded that this factor has a big influence on the care demand, and this will continue to influence the intellectual disability population even more in the future. According to Eggink et al. (2020), self-reliance is a factor that influences the intellectual disability population in the Netherlands. Next to the influence, it is possible to intervene here, to be able to make sure the influence on self-reliance will be less dramatic. Therefore these are key factors to consider further within this research.

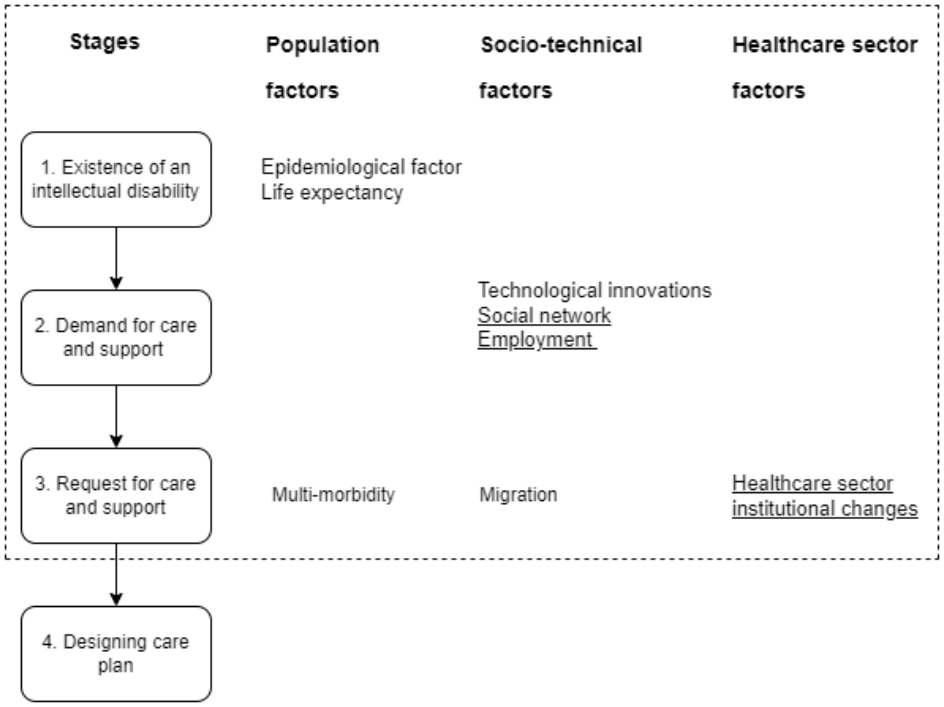


Figure 5: Overview of the factors influencing the intellectual disability population, based on the different stages and categorized

For the third stage, there was found that multi-morbidity, migration and healthcare sector institutional changes are factors influencing the intellectual disability population. Multi-morbidity occurs with the ageing intellectual disability population and influences their care demand. Nevertheless, this factor will increase the care needs when they grow older. Most of the intellectual disability sector already has an indication, which means only a re-indication is needed to provide additional care. The size of the total intellectual disability sector does not change based on this. Therefore, multi-morbidity is not considered a key factor. An increase in people with a non-Western background who apply for care was found. However, there was also stated this is some sort of 'catching up', meaning that this will not last forever. Migration is therefore also not considered a key factor. The healthcare sector's institutional changes are influential because they can influence how many people can receive care from the healthcare system and what that care looks like. So, this factors is considered a main factor.

5 Trends in intellectual disability sector

In this chapter, the historical trends of the intellectual disability sector in the Netherlands were explored, based on available data. With this trend analysis, the second sub-question was answered; *'What were the historical trends in the care demand in the intellectual disability sector in the Netherlands?'* First, a complete overview of the intellectual disability sector was analysed. After that, more specifically was looked at the care profiles. Combining the answer from this sub-question and the first sub-question, the key factors including the available data are found as input for the simulation model.

5.1 Total intellectual disability sector

The intellectual disability population has increased largely since 2015, as can be seen in Figure 6. To explore this increase over time, there will be looked at the trends in the different care profiles, VG3 till VG8. The trend in the total population of the other care profiles is shown in Figure 7.

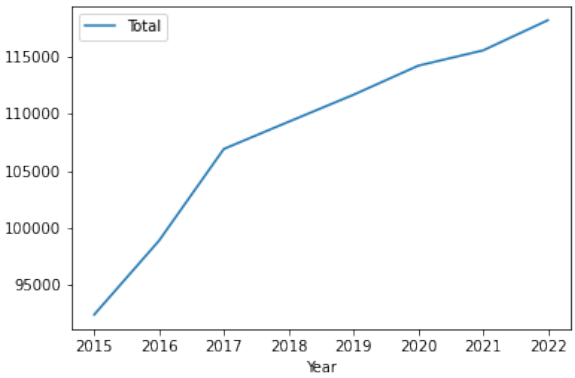


Figure 6: Intellectual disability population over time

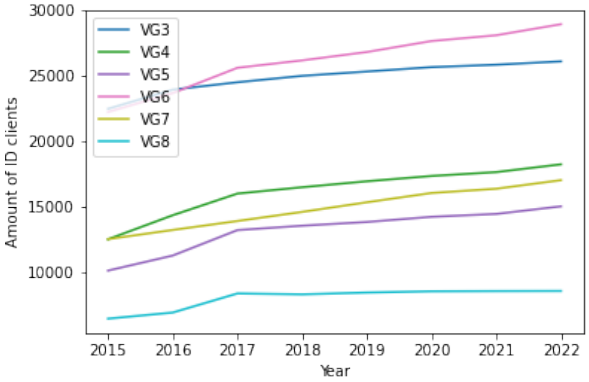


Figure 7: Care profiles over time

In both graphs, a kink was seen in 2017. This can be explained by the system change in 2015. The group of intellectual disability clients who had a VG1 or VG2 indication, but still wanted to receive care from the Wlz for the intellectual disability sector, needs to transfer to another care profile. In the two years after this system change, there was a special regulation allowing people to transit to another care profile, called *'overgangsrecht'* (National Health Care Institute, 2015). For that reason, the inflow will be larger than usual in 2015 and 2016 in some care profiles but stabilizes again after that. Not all people who had a VG1 or VG2 indication transferred to another care profile.

There is variety in the size of the care profiles. In Figure 8, the share of a certain care profile in 2022 is shown. VG3 and VG6 are the biggest care profile, with both around 25% of the total intellectual disability population, while VG8 is a very small care profile. The reason for this is that all the care profiles require a certain amount of assistance, which will require more time and money.

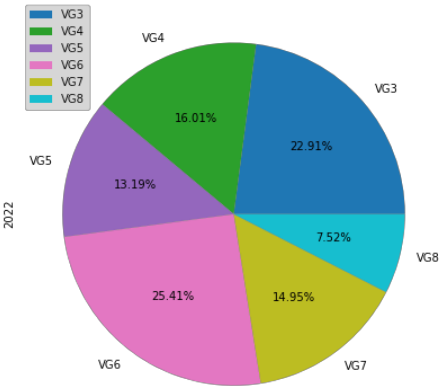


Figure 8: Care profile distribution

To consider the trends of the different care profiles over time, the available data about the inflow, outflow and transfer trends will be analysed. The inflow means all the newly granted indications for a specific care profile in a certain year. A new indication can be provided to someone who never had a Wlz or intellectual disability indication before or to someone who had a different indication but needs different care that fits another indication better. There were three main reasons someone was leaving a care profile in the intellectual disability sector; someone dies, transfers to another intellectual disability care profile or to the mental health sector, GGZ care. GGZ care is the mental health sector in the Netherlands, where they also treat behavioural problems which are common in some of the care profiles. Transfer trends will be analysed within the

intellectual disability sector, so the transfer from a specific intellectual disability indication to another intellectual disability indication. The main findings of the care profiles will be elaborated, and extended information and graphs can be found in Appendix D. But before diving into the different care profiles, the inflow and outflow for the total intellectual disability sector will be analysed.

In Figure 9 the total inflow and outflow are shown. The outflow is shown as a negative value because these people are leaving the intellectual disability sector and the inflow is a positive value since they enter the Wlz. It is clearly visible that the outflow of intellectual disability clients is stable over the years while the inflow decreased a bit. This decrease in inflow can be explained by the *'overgangsrecht'*, which was applicable between 2015 and 2017 to allow people to switch from VG1 and VG2 to another care profile after the system change. The magnitude of the decrease after 2017 will be partly caused by the more strict granting process of a care profile for the intellectual disability sector. After this decrease, the inflow stabilises. The different age cohorts which get an intellectual disability indication indicate that the older the age cohort, the fewer people will gain an indication. This supports the statement that most people already get the intellectual disability indication at a young age.

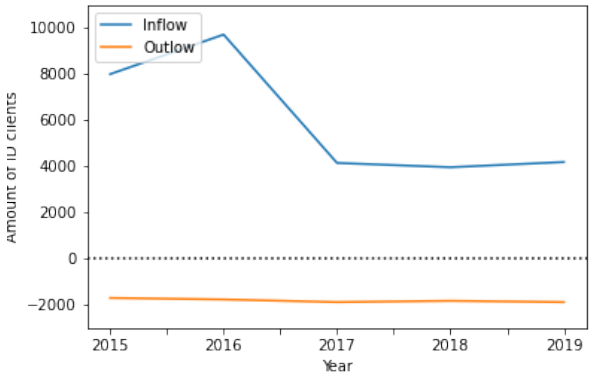


Figure 9: Total inflow and outflow of intellectual disability sector

Despite the decreasing inflow, the outflow of the intellectual disability sector is still twice as small. This causes an increase in the total intellectual disability population. Considering the different age cohorts who flow out, the biggest cohort is the group of 50 years and older, and not (almost) no people below 29. Comparing the 50 years and older cohort with the 29 to 50-year cohort, there is also seen that the 50 years and older is more than double in size. This is expected with the main reason for outflow; death. Next to this, people who flow out of a specific care profile could also be re-indicated to another care profile in the intellectual disability sector, which means that even fewer people will really flow out of the sector.

In the following paragraphs, two care profiles have been further explained in terms of the trends in the data. During the analysis of the data, it was found that most care profiles show the same trend. The only different trend is visible when looking at VG7. Therefore there is chosen to focus on two care profiles, VG3 and VG7. VG3 shows the trend that is generally found within the care profiles, and VG7 shows the deviating care profile. For the specific trends in the other care profiles, read Appendix D

5.2 VG3

The VG3 population can live a 'relatively' normal life. With some support and guidance, they are able to participate in social life as much as possible. This indicates that the care and support for this part of the intellectual disability population are small and in most cases lie largely on the social system of the client. Between 2015 and 2022 an increase of 16% in the VG3 population is visible, see Figure 10.

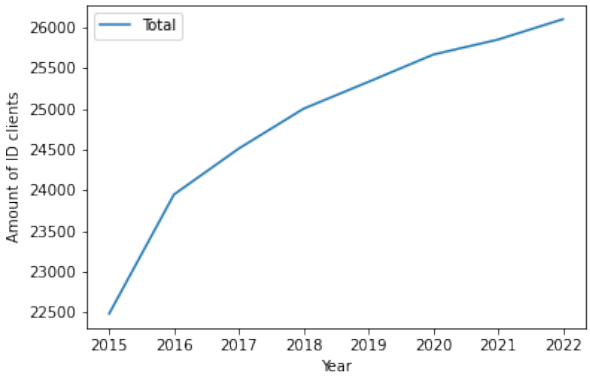


Figure 10: Total increase in VG3

Inflow and outflow Figure 11 shows the total inflow and outflow of VG3 from 2015 to 2020. A decrease in the total inflow is visible, just as was seen in the inflow of the total intellectual disability population. However, this decrease is more or less stabilizing after 2016. The outflow of the VG3 population is relatively small and stable over the years. In Figure 8 was already found that VG3 is the second biggest care profile and this also becomes clear in Figure 11. The inflow is more than seven times bigger than the inflow.

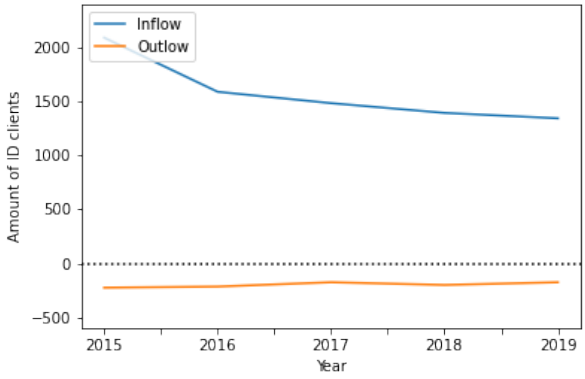


Figure 11: Total inflow and outflow of VG3

Looking more closely into the different age cohorts that get a VG3 indication in Figure 12, there can be seen that there are (almost) no minors who get a VG3 indication. The reason for this is the little care and support needed for this care profile. Since most of the minors live at home, this care and support can be provided by their parents or other relatives. If some additional guidance is needed, this will be covered by the youth care act. The problem for this age cohort arises when they reach adult age and want to live independently from their parents. Arrangements need to be made about their living situation and self-reliance. This also explains the high inflow of people between 18 and 29 years old.

When looking further back than 2015, there was found that VG3 has the biggest decrease in inflow compared to the other care profiles. This is mostly caused by the fact that in the past most people were first given the VG3 indication in the

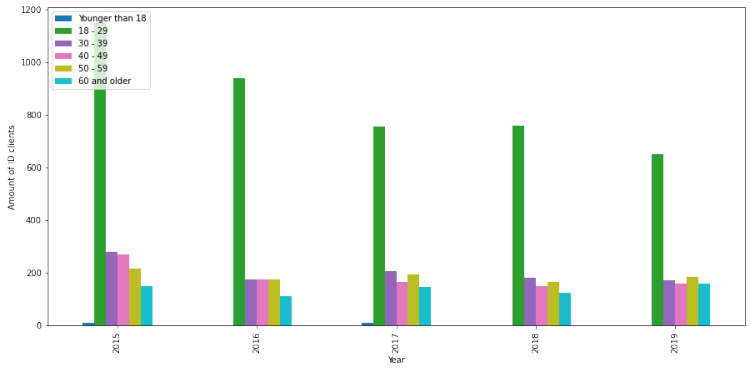


Figure 12: Inflow of VG3 based on age cohorts

first place. When that care was not sufficient, a re-indication was done. Today, a more thorough indication process is in place which will decide on the granted indication. This also gives a clear reason for the size of the care profile.

For the outflow of VG3, there is found that most people who flow out are 50 years and older. Since the main reason for outflow is death, this was also expected. However, as can be seen in Figure 13, there are also a lot of people leaving VG3 between the age of 18 and 49. A possible explanation for this is that VG3 is the 'lowest' care profile in the intellectual disability sector and that there are people who will need a different form of care during their lifetime and probably also more care when they grow older. A re-indication is needed for this changing care demand, and therefore there will also be people flowing out to another Wlz sector, which explains the second reason for the outflow of VG3. Since ageing is an important factor in the intellectual disability population and death is the main reason for outflow, it is also interesting to consider the average mortality age. This is shown in Figure 14, and there is clearly an increase in age visible over the years.

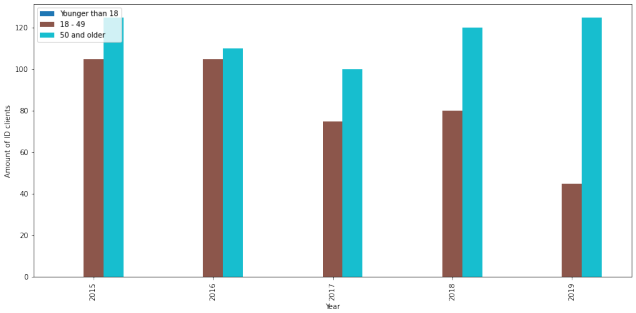


Figure 13: Age of outflow VG3 population

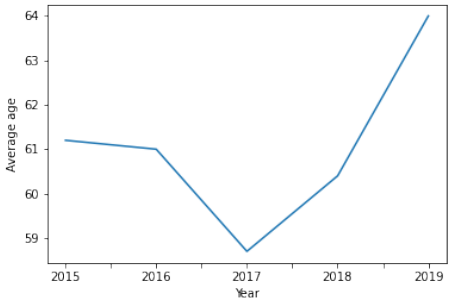


Figure 14: Average mortality age VG3 population

Transfer to another intellectual disability care profile If someone with a VG3 indication transfers to another VG care profile, they are mostly re-indicated for VG4, VG5 or VG6. There can be seen that no minor transfer to another care profile. This will have the same reason as mentioned before, minors will still be in the youth care act. Another interesting thing that becomes clear from Table 15, is that old people mostly transfer to VG4 and adults to VG6. Considering the increase in the VG3 population, seen in Figure 10, there was expected that the number of people who transferred to another care profile would also increase. However, this is not visible in the data. This means that comparatively there are fewer people transferring to another care profile over the years.

Transfer from VG3 to	Year	Total transfers	Younger than 18	18 - 29	30 - 49	50 and older
VG4	2015 - 2016	360	<10	80	105	170
	2016 - 2017	375	<10	80	105	175
	2017 - 2018	365	<10	65	110	190
	2018 - 2019	465	<10	65	125	260
	2019 - 2020	385	<10	60	120	195
VG5	2015 - 2016	145	<10	20	25	95
	2016 - 2017	170	<10	15	25	120
	2017 - 2018	180	<10	15	25	135
	2018 - 2019	175	<10	15	30	125
	2019 - 2020	155	<10	15	25	105
VG6	2015 - 2016	410	<10	175	145	85
	2016 - 2017	460	<10	180	165	120
	2017 - 2018	455	<10	145	185	120
	2018 - 2019	455	<10	160	170	130
	2019 - 2020	505	<10	170	185	145

Figure 15: Transfer from VG3 to other care profiles

5.3 VG7

A VG7 indication has a different form than the other care profiles, a distinction is made between a light Intellectual Disability and a severe ID. Both these client groups need intensive guidance due to the limitation caused by Intellectual Disability combined with behavioural problems. Also, psychiatric problems occur frequently within this group. There can be stated this is the most intensive care profile concerning time, effort and money. Since the data does not consider these two forms of a VG7 indication, there will be looked at as one group. In Figure 16, there can be seen that there is a very steep increase of 35% from 2015 to 2022.

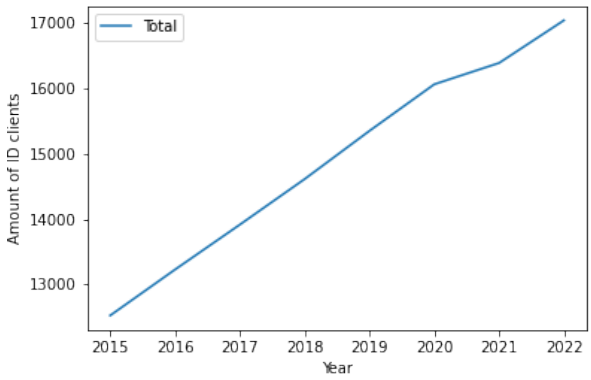


Figure 16: Total increase in VG7

Inflow and outflow In Figure 17, the total inflow and outflow of VG7 are shown. The inflow and outflow are both a bit fluctuating and relatively comparable. Considering the severity and challenges the care takes of this care profile are facing, there should be an extra careful indication process. Only the people who really need the intensity of the care from VG7 should be granted this indication. Therefore there is not a big influence from the system change as was seen in the other care profiles.

Regarding the different age cohorts which receive a VG7 indication, there is also a fluctuation visible. This increase is almost reaching the 2016 height. One of the problems the intellectual disability sector is facing is the increase in the severity of the disabilities. The increase in the inflow would support and prove this statement. An interesting observation of the

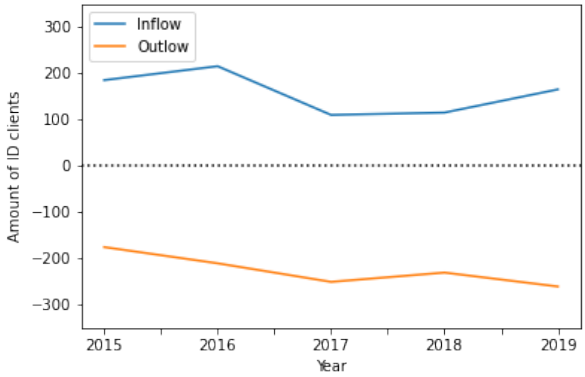


Figure 17: Total inflow and outflow of VG7

Figure 18 is that there are (almost) no elderly getting a VG7 indication. A possible reason for this can be that behavioural problems will be detected long before the age of 50 and are not likely to appear after this age.

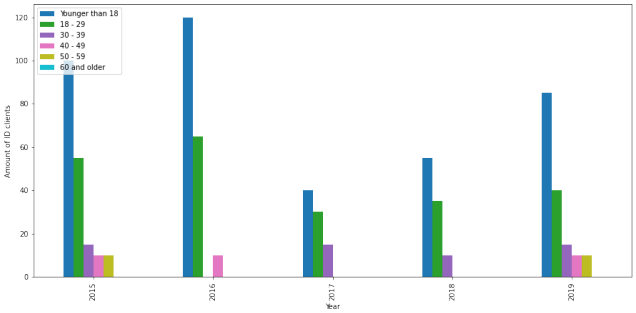


Figure 18: Inflow VG7 based on age cohorts

Since behavioural problems are very prominent in this care profile, it is expected that people who flow in are also coming from GGZ and that people who flow out of VG7 are going to GGZ. The interesting thing is that only a small group of people in 2016 come from GGZ and after that this does not happen again, seen in Figure 19. The same counts for the outflow of VG7, everyone going out of VG7 dies. This again shows the lack of collaboration between the GGZ sector and the Intellectual Disability sector.

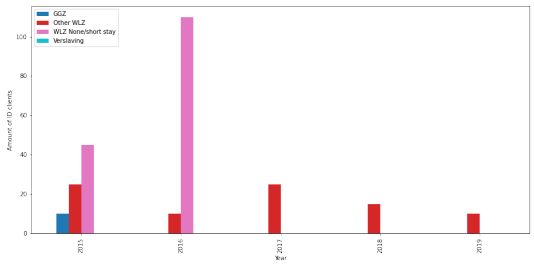


Figure 19: Inflow VG7 from another sector

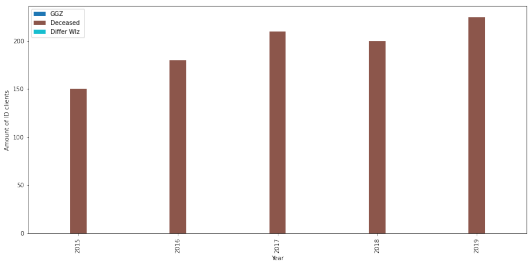


Figure 20: Outflow from VG7 to another sector

Transfer to another Intellectual Disability care profile Figure 21 shows the transfers from VG7 to another care profile. As was expected, with the complexity of this care profile, are there (almost) no people who get a re-indication. When someone is indicated with VG7, they have extreme behavioural problems. The only other care profile in the intellectual disability sector which treats behavioural problems is VG6. Therefore, if people get a re-indication, they transfer to VG6. The number of people who transfer is low and relatively stable over the years. Since this is the most intensive care profile to treat, this is a good thing. Next to this, are most people who transfer between 18 and 29 years old.

		Total transfers	Younger than 18	18 - 29	30 - 49	50 and older
Transfer from VG7 to	Year					
VG6	2015 - 2016	25	<10	15	<10	<10
	2016 - 2017	20	<10	10	<10	<10
	2017 - 2018	40	<10	25	<10	<10
	2018 - 2019	30	<10	15	<10	<10
	2019 - 2020	40	<10	25	<10	<10

Figure 21: Transfer from VG7 to another care profile

5.4 Conclusion data trend analysis

After evaluating the available data, the second sub-question can be answered; *What were the trends in the care demand in the intellectual disability sector?* Because not all the factors, found in Chapter 4, data were found, there is not a complete overview of all the trends in the intellectual disability sector. Some interesting and important trends found in the available data will be discussed.

What becomes clear from the beginning is the increase in the intellectual disability sector. This was also visible in the data, all the different care profiles showed an increase in the population of at least 16%, but most of the care profiles had an increase of at least 30%. This proves the statement that the care demand in the intellectual disability sector is increasing because all these people will need care.

The reasons for this increase in the population of the different care profiles were searched for within the inflow, outflow and transfer. The increase in the population of the different care profiles is mostly caused by the decrease in the outflow. Ageing is one of the reasons for this decrease. So, while there was found that the inflow to the intellectual disability sector decreased, the total intellectual disability population still increased because people will stay within the Wlz longer.

The hardest care profile to take care of is VG7. To give optimal care to these people, a lot of additional knowledge is needed to also treat the heavy behavioural problem that occurs. However, there are no clients who transfer to or transfer from the mental health sector in the Netherlands. If this would happen, the quality of the care for these people and the knowledge about this care would also increase. The lack of collaboration between the different healthcare sectors was already found before but is also proven in this care profile.

When combining the findings found in the literature and the data that was available, there is a lot of knowledge about the historical trends of the intellectual disability sector. These trends will form a clear input for the System Dynamics model that will be constructed to answer the third research question.

6 The intellectual disability model

In this Chapter, the conceptualisation and development of the System Dynamics model for the intellectual disability sector are discussed, to answer the third sub-question: *'How are the factors influencing the intellectual disability population connected in the Netherlands?'* Before developing the System Dynamics model, the conceptual model is designed and discussed in Section 6.1, including the model's purpose. After that, the model formulation is explained in Section 6.2. During the model formulation, the model design is further elaborated on, based on the different subsystems, the assumptions made to develop the model, and the model settings. Last, in paragraph 6.3, the model verification and validation tests are performed to evaluate the developed model. In this Chapter, an overview of the most important and noteworthy elements are discussed, for more detailed model documentation, see Appendix E, F, and G.

6.1 Conceptual model

In this Section, the conceptual model of the intellectual disability sector in the Netherlands is explored. Within the literature review (Chapter 4), factors influencing the intellectual disability population and the relations between these factors were found. During the data analysis, additional knowledge was gained about the (non-)importance of some of the factors. During the conceptualisation of the system, the complexity of a system can be better understood (Sterman, 2001). This is also the purpose of the model, to get a better understanding of the intellectual disability sector and the factors influencing this. The conceptual model designed for this system, based on the combined knowledge, is a causal loop diagram. The causal loop diagram mapped complexity and gave a better understanding of the feedback loops within the system.

In Figure 22, the causal loop diagram of the intellectual disability sector is visualized. It should be considered that this causal loop diagram was developed for the population with an IQ score below 85. Everyone with an IQ score below this can receive an intellectual disability indication. Within the causal loop diagram, multiple feedback loops are visible. Most of these feedback loops appear around self-reliance, indicating the importance of the factor. The other feedback loops focus on political interventions to enlarge the intellectual disability sector. Most of the studies performed were focused on the sector itself and how the facilities and resources should be better distributed. Since the purpose of this research is to understand the growth of the intellectual disability population itself, and reinforcing feedback loops were found, the focus is on the influence of self-reliance. The feedback loops concerning self-reliance are discussed further in this Section. A detailed explanation of the other relations within the diagram can be found in Appendix E.

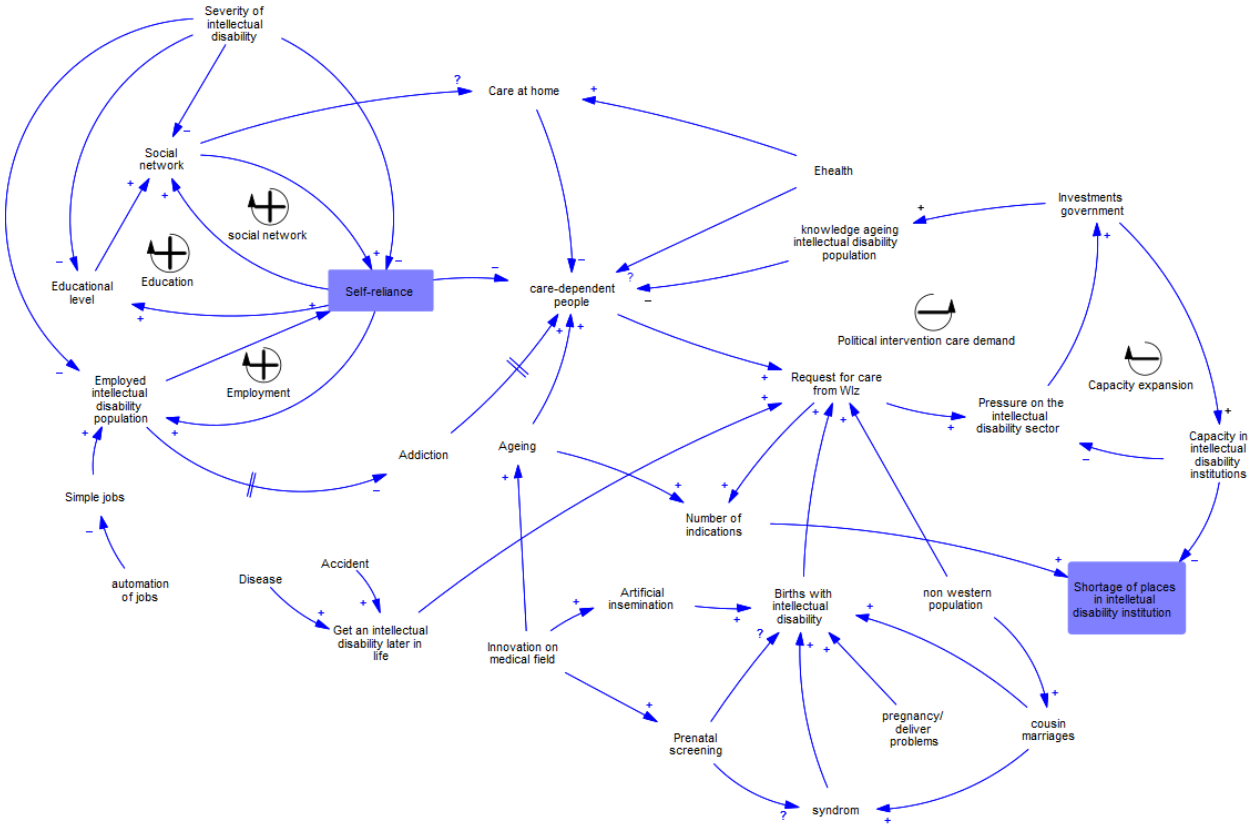


Figure 22: Causal loop diagram of the intellectual disability sector

In order to analyse the influence of self-reliance on the care demand in the intellectual disability sector in the Netherlands, the system will be studied using two key performance indicators (from now on: KPIs). In Table 3, an overview of the KPIs for the intellectual disability model are shown, and they are highlighted in blue within the causal loop diagram. For both KPIs, there were multiple versions, for each of the IQ groups.

Table 3: Overview of key performance indications (KPIs)

KPI	**Description**
Self-reliance	Self-reliance indicates the number of people with a low IQ who are self-reliant, meaning they will not be care-dependent.
Shortage in institutional places	The shortage is the difference between the number of people with an indication who want/need to live in an intellectual disability institution and the capacity of these institutions.

Figure 23 shows the self-reliance part of the causal loop diagram, including all feedback loops. As mentioned before, self-reliance can determine whether someone is care-dependent. However, self-reliance is a factor which is hard to measure, so there is only little data is available. To make self-reliance a measurable variable, which can be included in the System Dynamics model, the feedback loops were further explored. Three reinforcing feedback loops appeared around self-reliance, and not balancing loops. This indicated that the system either grows or declines and does not stop.

The first feedback loop that drives systematic behaviour and/or affects self-reliance is called *social network*. Someone with a low IQ has fewer social contacts, the quality of the contacts is lower and the ability and chance to make new social contacts is smaller compared to the general population (Eggink et al., 2020). Eggink et al. (2020) found that not only has someone with an intellectual disability less social contacts but people with a low IQ will also have fewer sort social contacts. Different sort of social contacts indicates that the social network can exist out of family members, friends, and/or neighbours. Having enough people within the social network can have positive effects on a person's self-reliance. Social

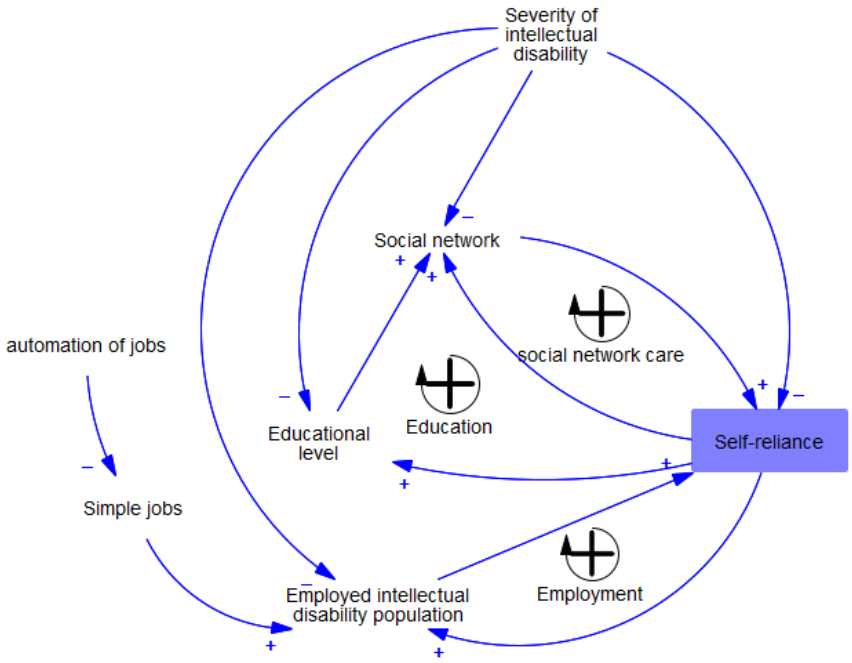


Figure 23: Conceptual model for understanding the social factors causing self-reliance to influence the intellectual disability sector

contacts support another social contact. Social contacts are able to provide care and support. However, someone having a social network does not always imply that this network is offering support and guidance. Some people will not be able to help and others might not be willing to help. Since one of the dimensions is social self-reliance, this indicates that when someone has a small social network, he or she is less self-reliant. Following that, when the self-reliance is lower, the ability to make new social contacts and maintain the current social contacts is lower. Meaning that the social network decreases again. A vicious circle can appear where the self-reliance keeps decreasing, indicating that the number of care-dependent people keeps increasing.

The second feedback loop that drives behaviour and/or affects self-reliance is called *education*. The ability of minors to go to a regular school has a influence on the minors' social network (National centre of expertise, n.d.). Minors with intellectual disability are not all able to go to a regular school, a big part of them goes to a special school. At these special schools are all children who need additional and individual attention. While at a regular school a bit more independence is expected of the minors. This means the minors are more eager the help each other and make new friends during that process. Also, children at a regular school partake in more social activities. The lower the self-reliance of the children, the less able they are to attend these general schools, and the fewer friends they can make. Being able to have a smaller social network, means then entering the feedback loop *social network*, where the self-reliance of the minors will decline even further. It should be noted that when the IQ score is below 50, minors will always need to go to a special school, so this loop does not count for that part of the population.

The third feedback loop that drives behaviour and/or affects self-reliance is called *employment*. The more people employed, the higher the self-reliance. When people are employed, they earn money, which gives them financial assurance and the feeling of more Independence (Eggink et al., 2020). As mentioned in Section 4.2.2, 'simple' jobs, which are most suitable for this population, are disappearing. As a consequence, the number of people who are care-dependent and possibly fall back on care from the intellectual disability sector increases. It can be noted that employment does not have an influence on the social network, while education level does. The reason for this is the type of jobs the people with a low IQ have. For the social network, there was looked for people who are able to support and care for another social network. During these simple jobs, most colleagues will also be people with a low IQ. Therefore, these people are not be able to support each

other with their care needs. Due to decreased self-reliance, the population with a low IQ is less able to get a job. Which again leads to less people being employed. Leading into a vicious circle of decreasing self-reliance.

The three feedback loops lead to the dynamic hypothesis. When nothing is done to interfere with these reinforcing feedback loops, self-reliance keeps decreasing for the intellectual disability population. Leading to an even larger group of care-dependent people who apply for care. Taking in mind the current pressure on the sector, it can be stated that the pressure can become unmanageable. To test the dynamics hypothesis, a System Dynamics model is developed, including three different subsystems: (1) a population subsystem, to analyse the number of people with a low IQ, (2) a self-reliance subsystem, to make sure the changes in self-reliance over time and the influence on the sector is modelled, and (3) the indications subsystem, in which the number of indications is modelled, including the capacity of the sector to evaluate the shortage of institutional places the intellectual disability sector.

6.2 Model formulation

In this Chapter, the different subsystems of the intellectual disability model are elaborated to give a clear overview of the structure of the model. A simplified overview of the System Dynamics model, with the three subsystems, is shown in Figure 24. The total system dynamics model consists of three different IQ groups, but only the population with an IQ score between 50 and 70 is shown. The other two IQ groups have the same structure. This figure was also shows how the different subsystems relate to the stages, as explained in Chapter 2. As mentioned before, the fourth stage is not included in the study. However, to give some same hints about the fourth stage, a rough assumption is made to have a complete overview. After the different subsystems is discussed, the most important assumption made to develop the System Dynamics model are formulated. The last paragraph explains the model setting of the System Dynamics model. For more detailed information on the three subsystems, please read Appendix F.

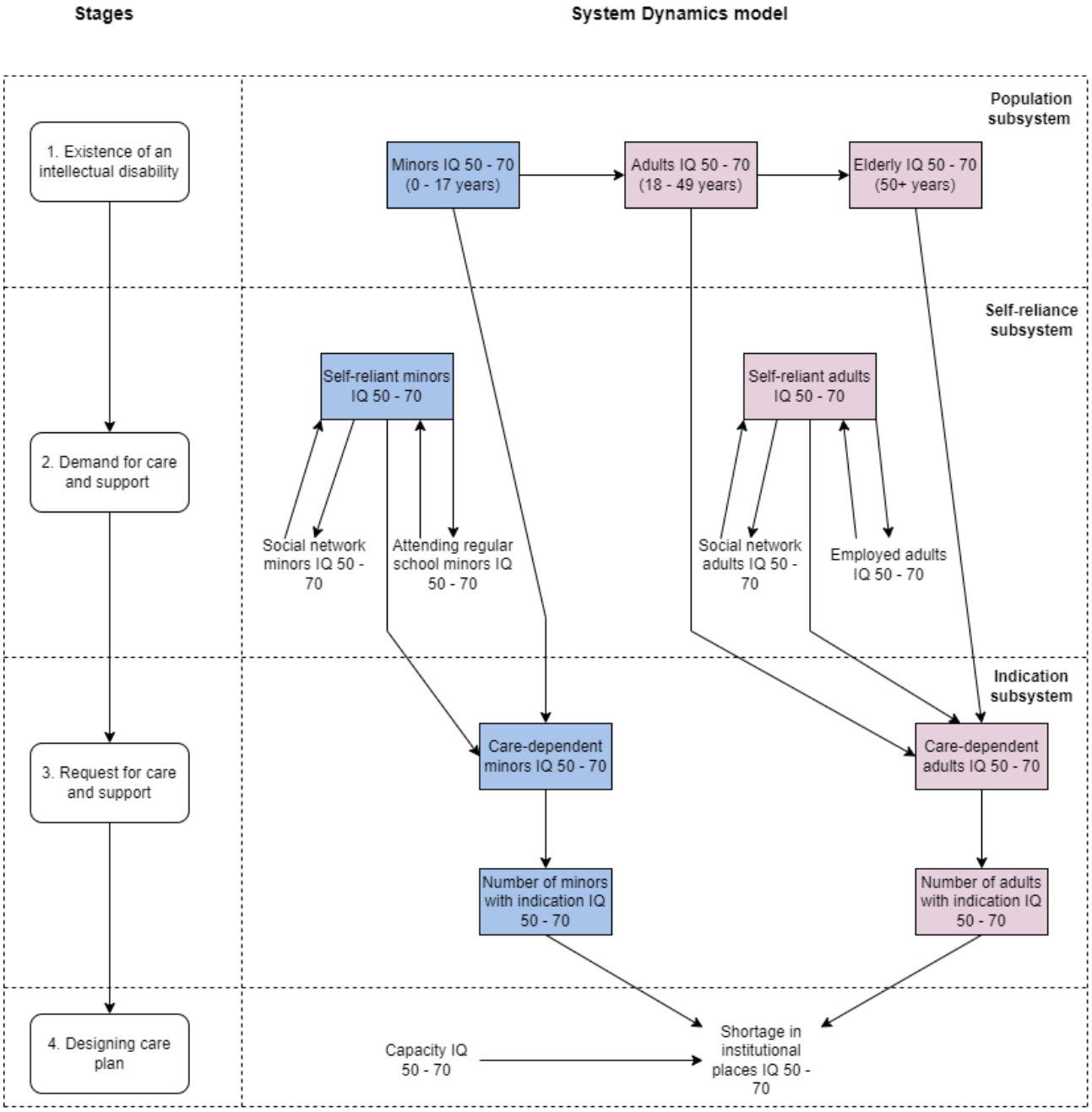


Figure 24: Overview of the System Dynamics model and its different subsystems

6.2.1 Population subsystem

The first sub-model is the population model, in which the possible intellectual disability population in the Netherlands was modelled. The possible intellectual disability population consists of people with a low IQ. As mentioned before, someone can receive an intellectual disability indication in the Netherlands when the IQ score is lower than 75 (National Health Care Institute, n.d.-a). However, people with an IQ score between 75 and 85 can also experience substantial limitations in adaptive functioning. This part of the population is called 'zwakbegaafd' in Dutch and they also need some kind of support. Depending on the severity of the adaptive functioning, this group can also receive an indication for the intellectual disability sector. Since self-reliance gives an explanation about adaptive functioning, this part of the population is also considered in the model.

Since there is a difference in the severity of the intellectual disability (partly) based on the IQ score, it was decided to split up the population into three sub-groups, as visualised in Figure 25. Besides this, the available data for self-reliance is based on the data of these IQ groups. The population with an IQ below 50 have a very severe intellectual disability and will always require care and support during their entire life. The part of the population with an IQ between 50 and 70 has a moderate intellectual disability and will, based on their self-reliance, need some care and support. Lastly, the population with an IQ between 70 and 85 have a light intellectual disability and also requires care and support based on the level of self-reliance, as mentioned above.

Figure 25: Representation of the intellectual disability population division of IQ groups

Besides to a distribution of the IQ groups, a distinction between different age cohorts was also modelled. In Figure 26, these three groups are shown. The first age cohort will be the minors, with an age between 0 and 17 years old. This group should be looked at separately from the other age cohorts because (almost) all minors still live at home during these years of life, and the care needs will be (mostly) fulfilled by their parents or other relatives. Their care and support needs will change once they become adults and want to live independently. The other two age cohorts are the adults, aged between 18 and 49 years old, and the elderly, aged 50 years and older. Since the intellectual disability population is ageing, just like the general population, it is necessary to split this group. The choice was made for the age of 50 because around that age additional physical conditions will mostly arise, which means their care and support needs will change again (Hoekstra et al., 2018). The data used to build this model is the same data used in Chapter 5, added with additional datsets from CBS.

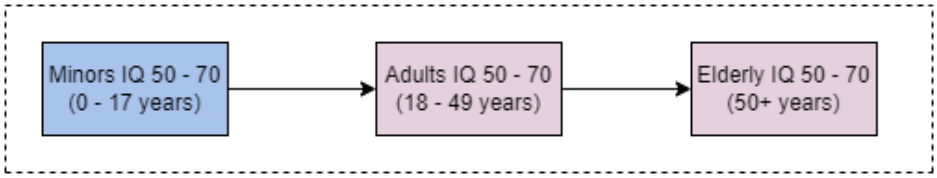


Figure 26: Representation of the intellectual disability population division of age groups

6.2.2 Self-reliance subsystem

The second subsystem is the self-reliance subsystem. This model evaluates the percentage of the population which is self-reliant. The group that is not self-reliant can be classified as care-dependent (Ras et al., 2010). The self-reliance of the population varies per age and severity of the intellectual disability. Therefore, this subsystem will also be divided into three separate parts, each for the IQ groups with an IQ score between 50 and 70 and 70 and 85. The population with an IQ score below 50 is not considered within the self-reliance subsystem, since everyone within this group will be care-dependent. The other difference with the previous subsystem is the age cohorts. In this subsystem, only 2 age cohorts are defined to analyse self-reliance, minors (0-17 years) and adults (18+). As was found in the previous Chapter, most minors still live at home and their parents provide the needed care and support. When parental care is not enough, additional care for minors is mostly provided by the Youth Care Act and only for a small part within the intellectual disability sector. Considering the intellectual disability aged 18 and older, this is completely different. As was found in the data, after the age of 18, most people enter Wlz. Therefore it was decided to make a distinction between these two groups. An additional reason is that important data on the self-reliance of the intellectual disability population also splits the population into those two cohorts, which was beneficial for the validation of the model.

Within these two age cohorts, different factors and different degrees of influence the dependency on self-reliance, shown in figure 4. Someone's self-reliance is based on different factors, as explained in Chapter 4.2. For this sub-model, the focus is on the social self-reliance of the intellectual disability population. Self-reliance is modelled as the percentage of the population who is not socially self-reliant. This percentage of the population is counted as care-dependent people. Social self-reliance is dependent on someone's social network. When someone's social network is large, self-reliance will be higher, since there are more people who could support them (Eggink et al., 2020). However, a big social network does not automatically means high self-reliance. Some people within a social network might not have to knowledge or time to support someone within their social network. Therefore it was decided to model the social network also decimal number. Meaning that someone with a social network score of 1 will also be able to really help and someone with a lower score will be in the social network but will not have the complete ability to guide. For minors, this is especially the case, since friends within their social network will also be children.

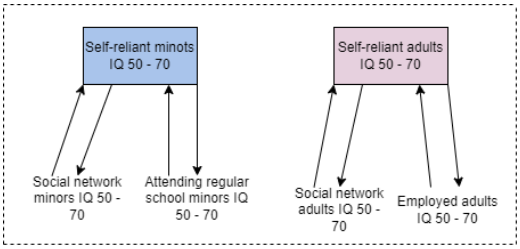


Figure 27: Representation of self-reliance subsystem

Someone's social network can also evolve over time. For minors, meeting new people will be mostly caused by going to school. However, most minors with an intellectual disability, are not able to attend a regular school. Therefore most of the minors attend a special school, that has experience with educating people with intellectual disabilities. The consequence of not being able to go to a regular school is that the chance of meeting new friends is higher at a regular school (Boezaard, Haitsma, & Nieuwenhuis, 2018; Eggink et al., 2020).

The self-reliance of adults was influenced by their jobs and also their social networks. As mentioned before, employment for the intellectually disabled population is hard and is partly disappearing. This has a negative influence on the self-reliance of this group and therefore increases the chance of becoming more care-dependent. It can be argued that having a job will also lead to a bigger social network. However, for this research, it was assumed that the intellectual disability population is not working full-time and has simple jobs. Therefore, the social contacts that develop within these jobs were not taken into account for the social network. Being employed does have an influence on self-reliance, and therefore it is an indirect influence of employment on the social network.

6.2.3 Indication subsystem

The third subsystem is the indication subsystem, which analysed the number of indications within the intellectual disability sector and compared this to the capacity. This comparison gives a indicator for the shortage of places within intellectual disability institutions. This is crucial information for the sector to be able to consider possible solutions. The indication process is shown in Figure 28. As mentioned above, the care-dependent population of a specific IQ group is dependent on the percentage that is not self-reliant. Not all care-dependent people apply for care from the Wlz. Therefore, an application rate is determined, to make this distinction. For minors and adults a different apply rate was implemented. Once the application is sent to the CIZ, it is evaluated and a decision about the indication is granted within 6 weeks. The total number of indicators is the number of applications which is approved by the CIZ. After the number of indications is known, they number of indications for minors and adults are summed up to compare to the capacity.

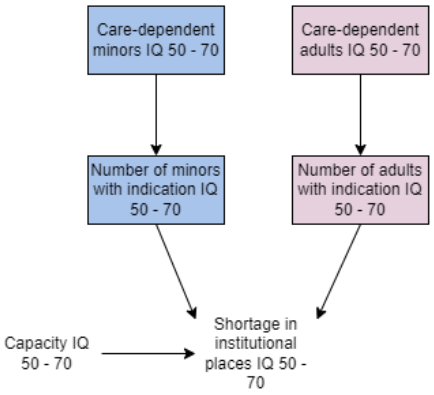


Figure 28: Representation of indications subsystem

Once the number of indications is known, it can be compared to the capacity of the specific IQ group. The difference between those two will be the shortage or abundance of institutional places within the intellectual disability sector. A place in an intellectual disability institution means someone lives within the institution full-time and receives all the care and support in there. Since the problem of this sector is that the intellectual disability population is growing and the sector is not able to cope with this expanding group, a shortage is expected.

6.2.4 Model assumptions

During the development of the three subsystems, several assumptions had to be made. These assumptions were made based on literature, in consolation with AT Osborne, and/or based on the researchers' own interpretation. All the assumptions are elaborated on in this paragraph.

Assumptions for the population subsystem:

- The population is divided based on different IQ groups. This distinction has been made because, for the intellectual disability sector, IQ scores are considered during the application process. Three IQ groups have been formed, IQ score below 50, IQ score between 50 and 70 and IQ score between 70 and 85. In addition, obtained literature and data about self-reliance were also based on these IQ groups. Since little data is available about the self-reliance of the population, it was decided to adjust the model to the available data.
- Someone's IQ score stays the same throughout their life.
- A distinction has been made on the mortality rate for someone with an intellectual disability and someone without an intellectual disability. The reason for this is the available data. Based on the CBS data, used in chapter 5, the mortality rate for the intellectually disabled population was calculated. This mortality rate was implemented for the population with an IQ score below 50 and an IQ score between 50 and 70 because according to CBS this is an intellectual disability. Since the population with an IQ score between 70 and 85 mostly receive care from the light intellectual disability care act it was decided to to use the same mortality rate as the general population.
- For the mortality rate for the general population and the population with an IQ score between 70 and 85, CBS data is used. However, since this data is based on the total population, which included the intellectual disability population, the mortality rate for the general population is lowered.

Assumptions for the self-reliance subsystem:

- A distinction is made between minors (till 17 years) and adults (18 years and older), following the research of Eggink et al. (2020) and Woittiez et al. (2019).

- Everyone who is not self-reliant is care-dependent. The group of people who are care dependent is used in the indications model.
- Everyone with an IQ below 50 is care-dependent and therefore does not include the self-reliance loop.
- For the two age groups, different factors influence self-reliance. For minors, the social network and ability to attend a regular school are included. For the adults, the social network and employment is included. For the specific influence of these factors on self-reliance, see Appendix F.2.2.
- All the intellectually disabled people who are employed have a 'simple' job. A 'simple' job indicates a job that does not require high education and can be from just a couple hours (Eggink et al., 2020).
- Someone's social network is measured in the number of contacts. However, itnis considered that not every social contact is able to care for and support another social contact. Therefore the number of social contacts can also be measured in a number smaller than 1.

Assumptions for the indication subsystem:

- The distinction made for the age groups in the self-reliance sub-model is also used in this subsystem.
- For the percentage of care-dependent people who apply for care, distinctions are made between the age groups as well as the IQ groups. Overall, minors apply very less for care, and the higher the IQ score, the less care-dependent people apply for care.
- It is assumed that the capacity is equal to the number of people who redeemed their indication for a specific form of care, namely living in an intellectual disability institution. This is assumed because at this point there is known that all the intellectual disability care providers are working at full capacity. There is not enough personnel to cover any more than there is at this moment.
- For the IQ score below 50, 90% of the people with an indication live in an institution. 60% of the people with an indication with an IQ score between 50 and 70, and 30% of the people with an indication with an IQ score between 70 and 85.

6.2.5 Model settings

The time period in which the System Dynamics model is simulated is from 2015 to 2070. The research starts in 2015 to check whether the model is simulating the first years correctly. In 2015, there was a system change, as mentioned before, and therefore it was different kind of data from before and after 2015 differs. For that reason, 2015 is chosen as the starting year. The model is simulated till 2070 to be able to simulate for at least 50 years. Since most of the data available about the intellectual disability sector are tracked in years, that is also the unit chosen for this model is years. To decide the time step, the sensitivity of the model was tested with different time steps. Eventually, 0.03125 was chosen, because this time step gave accurate results and showed no more oscillations. The Euler approach was chosen for the model, since the intellectual disability model is a discrete model, incorporating lookup functions. The System Dynamics model was developed in Vensim PRO X64.

6.3 Model evaluation

In this Section, the model developed in paragraph 6.2 is evaluated. Evaluation means the model was checked for errors and suitability for the purpose of the research (Forrester & Senge, 1980). The purpose of this model is to get a better understanding of the influence of self-reliance on the intellectual disability sector. Before testing the fit for the purpose of the model, the model itself had to be tested. This is called model verification and consists of several tests. The intellectual disability model is tested for the correctness of the coding, the dimensions of the model and for numerical errors. After the model is verified, it is tested for the fit of purpose, called model validation. Model validation again consists of several tests. The structure and behaviour of the model were evaluated. The structure of the model is tested based on the boundary

adequacy test. The behaviour of the model are validated, using the extreme conditions test and the sensitivity analysis. In this chapter, the results of the verification and validation tests are discussed. For a detailed explanation of the different tests, see Appendix G

The model verification examines the coding and consistency of the model. Since the model is about humans and their needed care, it should not be possible for the model to reach a value below zero. Despite the ability of the model to reduce self-reliance by having a negative effect, due to the use of special functions, it is not possible to have a result below zero for the variables. The only variable that is able to have a value below zero is 'shortage in institutional places', but this value is modelled in such a way. Another model verification test is checking the units in the model. The unit check consists of two tests. First, the units is manually checked, by examining whether the variables had a logical unit. Second, a unit check is performed with special software within Vensim. Once the tests are finalised, no unit errors are discovered. The last verification test is for the model settings. All the model settings, mentioned in Section 6.2.5, are checked and it can be concluded that the correct settings were used.

A boundary adequacy test is performed to test if the model boundaries and sub-models are accurately chosen in line with the model purpose. The purpose of this model is to get a better understanding of the intellectual disability system, based on the relation between self-reliance and the intellectual disability sector. For both of these variables, all the needed relations are put in the model, more specifically, each of the variables has its own subsystems. It could be argued that not the whole influence of self-reliance is put into the model. However, the most important factors influencing self-reliance, according to the literature, are used (Eggink et al., 2020).

For model validation of the behaviour, an extreme conditions test and sensitivity analysis are performed. These analyses provide insights into the behaviour of the model. During the extreme conditions tests the population and self-reliance of the three IQ groups were set to extreme values to test the influence on the KPIs and compare the results with the base case. During this test, it can be concluded that the model behaved as predicted.

After the extreme conditions test, a sensitivity analysis is performed to examine the assumptions made during the development of the model. A distinction is made between numerical and behavioural sensitivity. For all the IQ groups, it was found that the shortage of institutional places, one of the KPIs, there are no behavioural sensitivities and just small numerical sensitivities for some of the parameters. The numerical sensitivity for this KPI was found for the population with an IQ score between 50 and 85. For self-reliance, numerical and some behavioural sensitivity were found. However, since self-reliance is difficult to measure and a lot of assumptions were made, this is a logical consequence. Especially for the effect of self-reliance on the ability to attend a regular school for children with an IQ score between 70 and 85, an interesting behavioural sensitivity was found. Based on the sensitivity analysis, it can be concluded some better assumptions have to be done for the self-reliance sub-model. However, it was possible to get clear insights into the relationship between self-reliance and the number of indications.

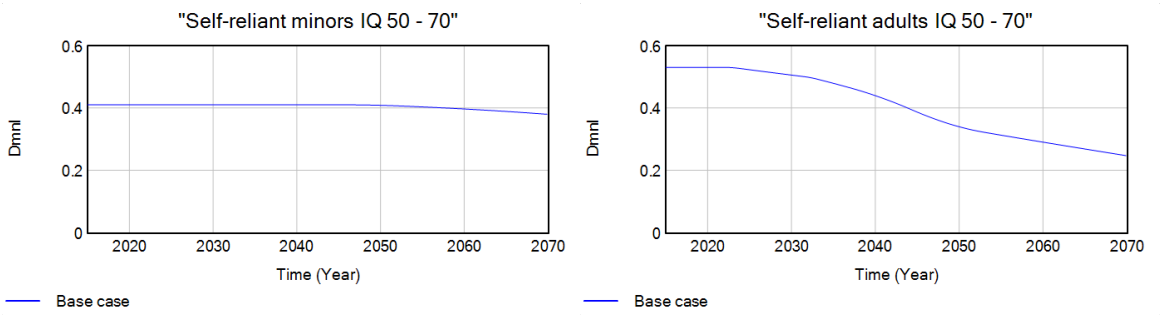
Based on the results from the various verification and validation tests, it can be concluded that the intellectual disability model has the correct setup and structure and it shows the expected behaviour to gain additional information about the influence of self-reliance on the sector. Since sensitivity was found for the self-reliance of the different IQ groups, the model was not fit for policy interventions yet. However, it should be noted that the model was primarily used for further substantiation of the qualitative conceptual model. With that in mind, the feedback loops surrounding self-reliance can be tested and analysed, which also proves the fit for purpose.

7 Intellectual disability model results

In this Chapter, the results from the intellectual disability model are shown and elaborated on. The additional knowledge gained for the conceptual model for the influence of self-reliance on the intellectual disability population is formulated and answers the fourth sub-question: *'How do the interconnected factors influence the behaviour of the intellectual disability sector in the Netherlands?'* This information helps the sector in finding out where to improve. The base case results are the results from the model run, with the improved version after the model testing. For the base case results, the KPIs, as named in Table 3, are visualised.

7.1 Base case outcomes self-reliance

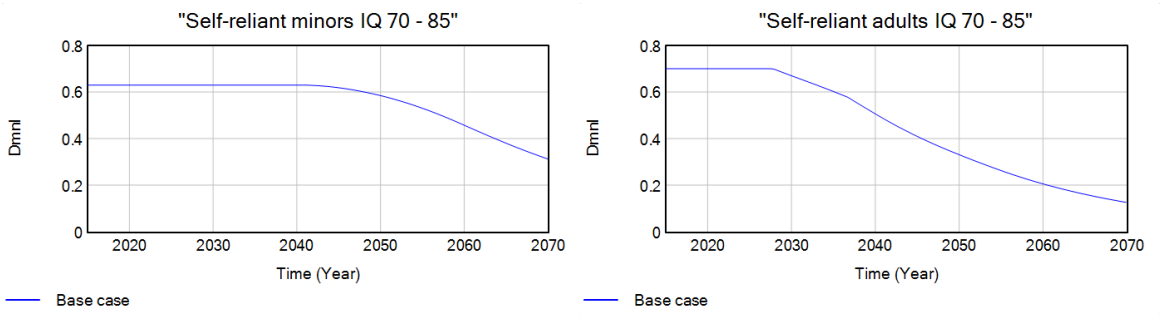
Figure 29 visualises the results for the self-reliance of minors and adults with an IQ score between 50 and 70. As mentioned before, most minors still live at home with their parents, who take care of them at least until the age of 18. Besides, not a lot of minors within this IQ group are able to attend a regular school. The self-reliance is already relatively low for this group and with not a lot of changes to their environment, the self-reliance will not change drastically. For that reason, their self-reliance and the ability to change the self-reliance is lower compared to adults. In Figure 29 this is also clearly visible. For adults, the self-reliance can be influences more. A possible reason for this is that, despite the chances are that the parents are still alive, a lot more should be done individually by adults. Once their job disappears or someone in their social network who used to support them disappears, the chances of that person remaining self-reliant and not need care from the intellectual disability sector are small. for this group, children are generally less self-reliant.



(a) (b)

Figure 29: Base case results for self-reliance (a) minors or (b) adults with an IQ score between 50 and 70

For the population with an IQ score between 70 and 85, the results for self-reliance are shown in Figure 30. For this IQ group, the influence on the adults is again larger than for the minors. However, the influence of the minors does show a bigger increase than for the minors with an IQ score between 50 and 70.



(a) (b)

Figure 30: Base case results for self-reliance (a) minors or (b) adults with an IQ score between 70 and 85

Considering the difference between the self-reliance of the two IQ groups, it can be concluded that the influence is larger for the population with an IQ score between 70 and 85. A possible explanation is a difference in fundamental care needed. For the population with an IQ score between 50 and 70, there is always some care and support needed during their life. When there is a small influence of the social network, ability to attend a regular school or being employed, this has a smaller influence, because the care they already have only had to be extended and the self-reliance changes then only a bit. On the other hand, for the population with an IQ score between 70 and 85, the biggest part of the group does not need fundamental care, so when there is a little change in the factors influencing self-reliance, this will have a greater impact on the self-reliance. In the end, it should be noted that for that part of the population, the self-reliance level and how that affects them in terms of care-dependency is very hard to predict. However, when this part of the population is all of a sudden also applying for care from Wlz, the sector is not able to provide all this care. So, this part of the population should be watched closely to avoid this.

7.2 Base case outcomes shortage of institutional places

Figure 31 visualized the results for the shortage in institutional places from the base case. A large shortage is visible in all three graphs after a short amount of time. One of the reasons for this research was the size of the intellectually disability population and the pressure that gave on the sector. These graphs prove the intensity of the problem and urge for a solution.

Looking more closely at the three different IQ groups, a distinction can be made between the population with an IQ score below 50 and the other two IQ groups. For the population with an IQ score below 50, a small softening of the increases is visible. While for the other two IQ groups, the shortage is getting bigger every year. The main reason for this is the inclusion of the self-reliance sub-model for the two IQ groups. This also proves that self-reliance does have an influence on the intellectual disability sector.

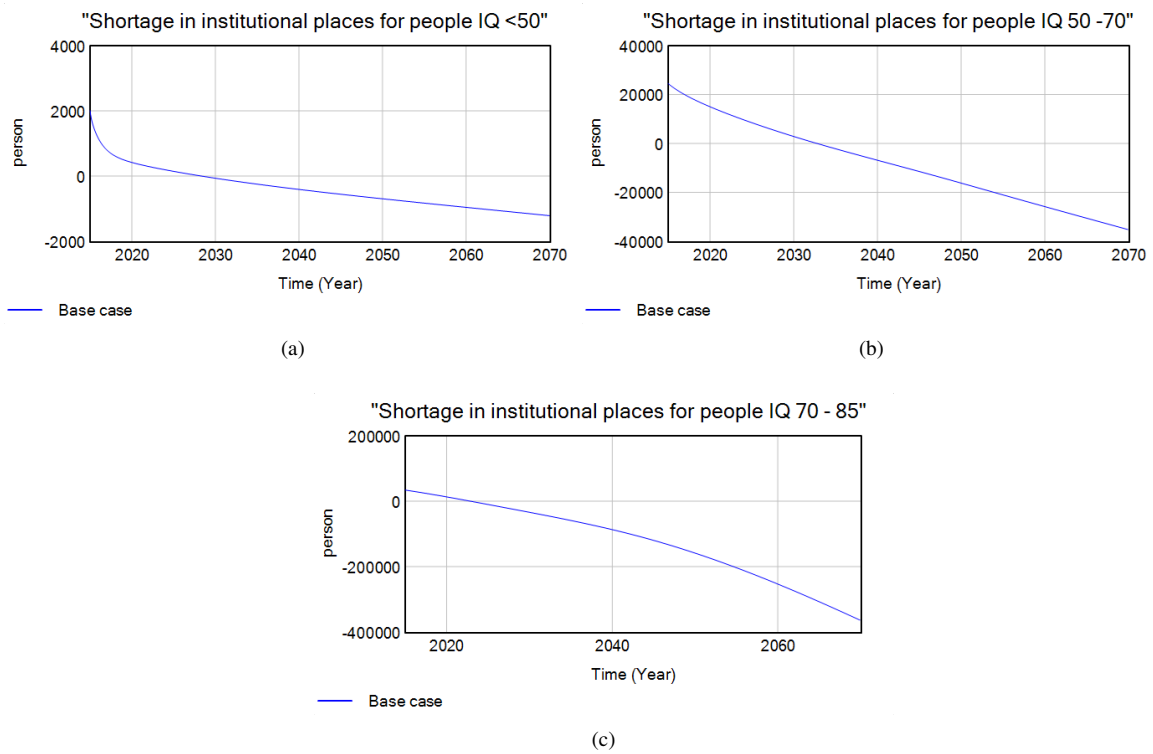


Figure 31: Base case results for shortage in institutional places for the three IQ groups (a) IQ < 50 or (b) IQ between 50 - 70, and (c) IQ between 70 and 85

In figure 32, the total growth in the population of the different IQ groups is shown. There can be seen that over time, the total population for the three different IQ groups, does not increase largely. The biggest increase is seen for the population with an IQ score between 70 and 85, in Figure 31c. However, this is also the biggest group compared to the other groups. When this population growth is compared to the growth in shortage this does not align for the two IQ groups which include self-reliance. This indicates that the decrease in the self-reliance of these groups has a big influence on the number of people who receive an indication for the intellectual disability sector.

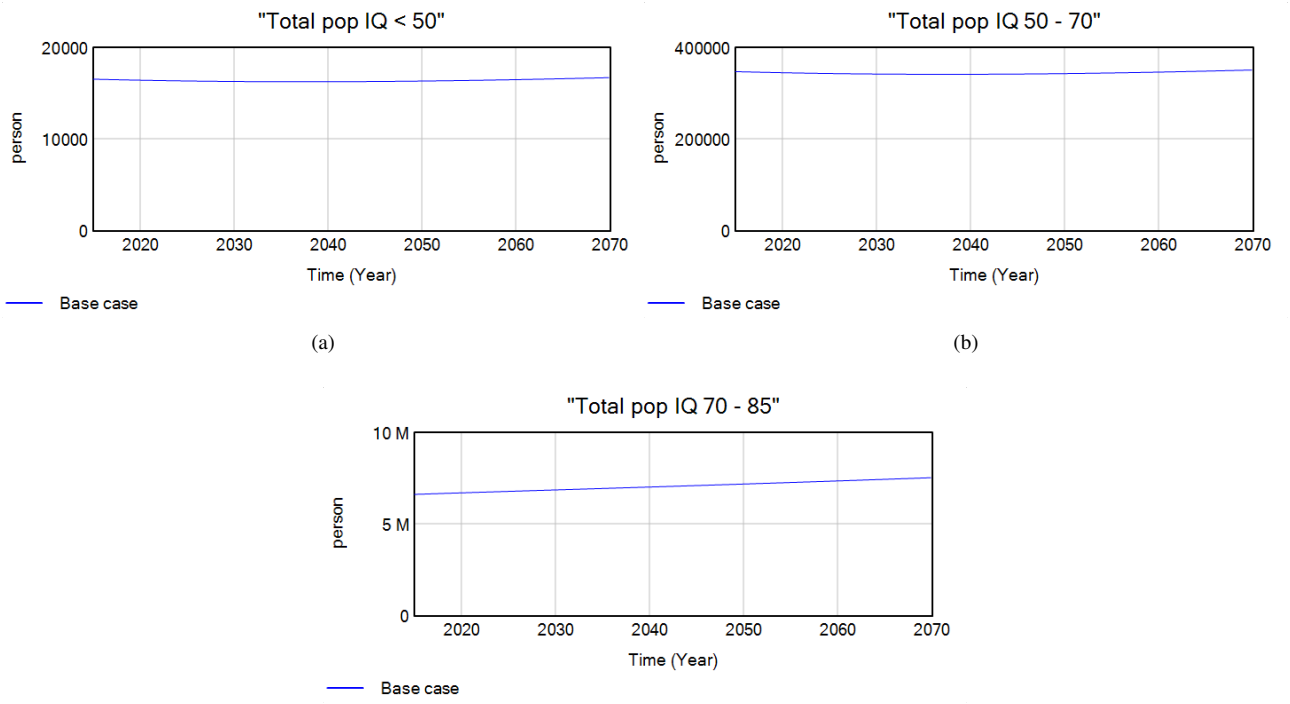


Figure 32: Base case results for the population of the three IQ groups (a) IQ < 50 or (b) IQ between 50 - 70, and (c) IQ between 70 and 85

7.3 Base case conclusions

Based on the results, it can be concluded that the self-reliance of someone with a low IQ influences the number of people who will apply for care from the Wlz. Looking back at the dynamic hypothesis, this means when no interference happens within the self-reliance loops, the sector is not able to cope with all the people applying for care. Another consequence of this could be that these people, who do need care and are not able to receive it, can experience even worse consequences. As was visualized in the CLD, this could for example lead to addiction.

8 Discussion

In this Chapter, the discussion of the study is elaborated on. First, the results are compared to existing literature. After that, the limitation of the research are explored. Last, several recommendation are done for future research and policymakers.

8.1 Comparison of results with existing literature

8.1.1 Comparison of the results from the data analysis phase with existing literature

During the data analysis, three factors that emerged in the literature review could be excluded as key factors, namely epidemiological factors, life expectancy and migration. In addition, it was found that the overall population of intellectual disabled people is growing rapidly and does not seem to end in the near future.

The first factor that could be ruled out was the epidemiological factor. The number of new indications granted did not increase at the same rate as the growth of the intellectual disabled population. This suggests that no increased number of people are born with intellectual disabilities or acquire intellectual disabilities later in life. During the literature review, the influence of epidemiological factors on the growth of the intellectual disabled population was already questioned (Staalduinen & Voorde, 2011; Kuppermann et al., 2011; Acharya, 2012). According to Staalduinen and Voorde (2011), other factors have more influence on population growth, such as a complex and demanding society. Therefore, it can be argued that epidemiological factors are not the main cause of the increase in the intellectual disabled population.

The second factor that is excluded is life expectancy. An analysis of the data found an increase in mortality age among the population, on average from 60 to 63 years. However, the number of people above 70 years of age is found to be large. Nevertheless, the increase in life expectancy does not lead to the seen increase in the intellectual disabled population. In the literature, the growth in life expectancy was also found (Lin et al., 2016; Doody et al., 2012; Evenhuis, 2011; Biezen et al., 2022; Staalduinen & Voorde, 2011; Gommans & Offringa, 2022). However, they found that the main cause due to the increase in life expectancy is the increase in population vulnerability. Therefore, it can be argued that while life expectancy has some impact on population growth, it is not the cause of the huge growth seen.

The third factor that can be ruled out is migration. As already noted by the Gommans and Offringa (2022), the increase in the population with intellectual disabilities from non-western backgrounds is mainly caused by a 'catch-up effect' (Ministry of Health, Welfare and Sport, 2017). This was also seen in the data analysis, the number of people from non-western backgrounds receiving a new indication for intellectual disability seems to have stabilised over time. Together, this indicates migration is not the main cause for the growth of the intellectual disability population.

The exclusion of epidemiological factors and the increase in life expectancy together rule out the first stage of the intellectual disability stages, the existence of an intellectual disability, as explained in Chapter 2. Again, it emphasises that the increase in the population with intellectual disability is not caused by the existence of the disability, but by socio-technical factors or healthcare factors that cause the increase.

Besides the exclusion of some factors, the growth of the intellectual disability population was confirmed. Since 2015, the intellectual disability populations has increased with 28% in the Netherlands. Reason enough to investigate the cause further. The factors found important during the literature review, technological innovations, social networks, employment, and healthcare sector institutional changes in the care sector cannot be confirmed by the data. On the other hand, they are not excluded, which also gives some more clues about the importance of these factors.

8.1.2 Comparison of the results from the modelling phase with existing literature

Because of a better understanding of the causal links and mechanisms of self-reliance and its impact on the intellectual disability sector, a first attempt at a quantitative model was designed. The causal loop diagram revealed three reinforcing feedback loops around self-reliance. This indicated that the system is either growing or declining as identified in the literature phase (Eggink et al., 2020). The Ras et al. (2010) stated that the level of self-reliance of the population has increased over the years and will continue to increase. This would indicate that the negative effects of the feedback loop could occur earlier or more drastically for the intellectual disabled population. In addition, the Woittiez et al. (2019) also points to the difficulty of measuring and changing self-reliance for the intellectual disability sector.

For this research, the factors influencing self-reliance that were studied were the size of the social network, the ability to attend a regular school, and whether or not someone with a low IQ score was employed. These factors cover the social dimension of self-reliance and a small part of the administrative self-reliance dimension (Eggink et al., 2020). The choice to focus on these three factors of self-reliance was made based on literature (Woittiez et al., 2019; Eggink et al., 2020). They state that for the intellectual disability population, these three factors have the largest influence on self-reliance and therefore on the number of people with an intellectual disability indication.

The relation of these individual factors on self-reliance was known. The added value of this literature was the understanding of the mechanisms that occur between these relationships and their influence on the intellectual disability population. As mentioned, the quantitative model was the first attempt to quantify these mechanisms and further evaluate their influence. The dynamic hypothesis posited that when there is no interference from the feedback loops, self-reliance continues to decline and the intellectual disability population continues to increase. Despite the many assumptions that had to be made and some sensitivity found in the model, some initial thoughts on the effect were found. The initial results of the quantitative model provided no evidence to reject the dynamic hypothesis, a decrease in self-reliance was found.

The results of the quantitative model show a greater impact on self-reliance for adults than for minors. As found in the literature, minors need to be less self-reliant because they usually still live at home and are cared for by their parents (Woittiez et al., 2019). This also explains the small change in self-reliance in the underage population. There is also a difference between the population with IQ scores between 50 and 70 and 70 and 85. This too comes from the literature (Woittiez et al., 2019). Comparing these results with the effect on the deficit, it can be seen that a decrease in self-reliance does have a negative impact on the shortage.

A noteworthy point of discussion for this model is the options for increasing the self-reliance for the intellectual disability population. The vicious circle appearing for a decrease of self-reliance, does not indicate that this circle also appears for the increase in self-reliance. As is mentioned by several articles, providing support and guidance for the intellectual disability sector has to be customised as is not easy (Eggink et al., 2020; Ras et al., 2010). So this research shows the negative sides for of the decrease of self-reliance and possible interventions can be thought of to stop the decrease. But to increase the self-reliance of the intellectual disability population, more knowledge should be gained.

System Dynamics was used as an approach for this phase. Already during the literature review, feedback loops, causal links and material and information flows were found, making this an appropriate method. System Dynamics made it possible to visualise and understand the interconnectedness of the factors in a conceptual model. With the number of assumptions that had to be made, System Dynamics was also a good tool to test these assumptions. Other simulation modelling approaches, such as an Agent-Based model could also be an appropriate simulation modelling approach to investigate particular aspects of the system. For example, Agent-Based models could describe the many choices that happen in the intellectual disability system in the Netherlands. System dynamics was chosen for this study, as it is more suited to evaluate the feedback loops and influence of causal links and feedback loops within the system.

8.2 Limitations

8.2.1 Limitations of literature review

The literature review has two limitations. The first limitation is caused by the search query used. One of the concepts in the search was *'high-income countries'*. Using this term might have resulted in limited literature, as not all literature uses this term. However, there is a reason for adding this term to the search. Each country has a different healthcare system, with different rules and regulations. As this literature review evaluates both global and national literature, *'high-income countries'* should be added to increase the chances of finding factors that also apply in the Netherlands. Moreover, by also evaluating grey literature, the factors found were evaluated based on Dutch literature. In addition to the results of the search query, a targeted search was performed for the factors. Altogether, this avoided the limitation of restricted results.

The second limitation of the literature review is the scope used for self-reliance. It was decided to focus on the social network, education level and employment of the intellectual disability population, while there are other dimensions. Therefore, not the whole self-reliance of the population is captured, which could lead to a different influence. However, the choice to focus on these three factors for the influence on the self-reliance of the intellectual disability population was made because these are indicated to be most important for this population (Eggink et al., 2020).

8.2.2 limitations of data analysis

For data analysis, there were two limitations. The first limitation concerned the lack of data. As a result, not all factors found during the literature review could be assessed for their importance. However, an overview of trends in the intellectual disability sector was found in the data and three of the factors from the literature review could be excluded as important. Another reason why the data analysis was useful was that the data could be used as initial values for the System Dynamics model.

The second limitation concerned the choice of the Wlz sector. Besides the intellectual disability sector, there is also a sector concerning mild intellectual disability and severe behavioural problems in mild intellectual disability. Since the study first focused on IQ scores, part of this group qualifies for one of these sectors, especially the group with an IQ score between 70 and 85. However, these sectors grant indications only for a limited time and are mostly for people under the age of 23. Therefore, several factors need to be taken into account to add these sectors and we chose to focus on the intellectual disability sector itself.

8.2.3 Limitations of model and model assumptions

Several assumptions had to be made during the development of the model. The assumptions made are the limitations of the model. The use of assumptions is an unavoidable but useful way to quantify the model and deal with the lack of specific data. The impact and choice of assumptions are discussed. The first assumption was the distribution of the three IQ groups, IQ score below 50, IQ score between 50 and 70 and IQ score between 70 and 85. This division was made based on the only data available. This division was made based on the only data available on self-reliance. The choice to include the population with an IQ score between 70 and 85 was made because these people may also receive an indication when their adaptive functioning is very low. Since this model examines the influence of self-reliance, which more or less includes adaptive functioning, it is important to include this part of the population as well. The consequence of this choice could be a slight overestimation of the number of people with an indication within this IQ group. However, this has been taken into account when determining the application rate. The choices for this distribution were thus made based on available data and knowledge.

The second assumption was the distribution of the population into two age cohorts, minors (0- 17 years) and adults (18+ years). The choice to divide the population into these two groups was made, just as with the IQ distribution, based on the available data about self-reliance. This distinction is not important for all perspectives. From a System Dynamics view, the distinction is not a limitation, just a choice of modelling. On the other hand, for stakeholders with an interest in influencing the sector, like AT Osborne or policymakers, this distinction is important to consider. In the data was found that most people entering the Wlz between the age of 18 and 29 and that after a while the care needs for the population change with a possible re-indication. With this assumption, this was not considered, but the most important distinction that should be made for age cohorts is the distinction between being a minor or not, and that was included within the model.

Furthermore, to be able to use the data found in the second phase, the care profiles had to be distributed amongst the IQ groups. Since the care profiles are classified also based on very individual and personal care needs, rough estimations had to be made about the distribution. To validate this assumption, contact was made with the CIZ. During this meeting, the experts did not completely agree with the assumption. Based on their experience, they state the distribution of the care profiles amongst IQ groups is difficult because there are too many cases in which such a distribution would not be fitted. Unfortunately, there was not enough time to implement different and improved assumptions. Since the data used for the model were based on the facts and only the distribution of the data was incorrect, the model was still able to evaluate the influence of self-reliance on the intellectual disability population. When the purpose of the model changes to evaluate the actual shortage in institutional places for the intellectual disability sector, these assumptions have to be improved.

In addition, an assumption was made for the number of deceased people with a low IQ score. For the model, three separate sub-models were designed. In the third sub-model, the indications model, the number of deceased people were modelled based on the average time of life. While in the population sub-model the number of deceased people was modelled based on a mortality rate. It was not possible to use the number of deaths from the population sub-model because these deaths did not consider some people being self-reliant and others possibly not applying for care. Therefore, there is chosen to use the average age of the population with a specific IQ score. The consequence of the inconsistency is that the number

of indications might be a bit too high compared to reality. However, since the number of deceased people should be incorporated within the indication sub-model, using the average age is a good assumption.

Another assumption about the validation had to be made within the self-reliance sub-model. As discussed before, almost no data was available about self-reliance. Different assumptions are counting for the whole self-reliance sub-model and assumptions for specific relationships within the self-reliance sub-model. First the bigger assumptions. According to Woittiez et al. (2019) adults have, in general, a higher self-reliance rate than minors and the higher the IQ score, the higher the self-reliance percentage amongst the group. For minors, this means that the effect of and on self-reliance is very small. Another reason for this is also because minors do not have to be very self-reliant, they live at home and are cared for. The real problem occurs once they grow up and want to live independently because this was used during the decision on the specific assumptions between relationships within the model.

The influence on self-reliance for minors first. Minors with an intellectual disability can have the capability to attend a regular school if the disability is not too severe. However, the rules and regulations in regular schools are too strict and inflexible for these groups of children to be able to participate (VGN, 2018a). They are forced to go to a special school, while with little more attention, they could have stayed in the regular school. Since this is the biggest opportunity for this group to expand its social network, this influence on the social network is bigger than the influence of self-reliance. During the validation of these assumptions, there was found the influence of the ability to attend a regular school for minors with an IQ score between 70 and 85 showed some behavioural sensitivity. Some sensitivity was also expected for self-reliance since so many assumptions had to be made. This also emphasized that the model could not be used to figure out exactly how many people with have an indication, but the behaviour of the system can still be used to get a better understanding of the relation between self-reliance and the intellectual disability sector.

The influence on self-reliance for adults second. For adults, the effect on employment is larger on self-reliance compared to the social network. A reason for this is that in today's society, people are less willing to help each other which makes it also more difficult to predict whether someone's social network influences self-reliance (Ras et al., 2010). On the other hand, being employed allows people to have daytime activities and financially take care of themselves. This increases their independence level and self-reliance. Especially for people with an IQ score between 70 and 85. Most of this group, who is employed, can live a relatively normal life, once this job disappears they will become care dependent. Once they get care-dependent, there is a higher chance they will apply for care.

Based on all these assumptions, the model was simulated. Since not all the assumptions could be validated, the numerical results could not be used to show the capacity shortage of the sector. However, the model was able to show the behaviour of the model and found that self-reliance does influence the number of care-dependent people who apply for care from Wlz.

8.3 Recommendations

8.3.1 Recommendations for future research

This Chapter makes recommendations for future research. The first recommendation would be to re-evaluate the assumptions. The reassessment could be done, for example, with expert interviews. For future research, such an expert interview should be done earlier and probably with several expert institutions. During these interviews, the designed model should also be used to see whether their mental models and understanding of the system, change. Three assumptions in this model could be improved during such interviews.

The first assumption that could be improved is the classification of the population into IQ groups and combined with the care profiles. During contact with experts from the CIZ, it appeared that the division of care profiles into IQ groups could be improved. If this assumption is improved, more knowledge can be obtained about how many people from a particular IQ group apply for care. In addition, the capacity of the mentally disabled sector can then also be included, giving a better understanding of the sector's deficit.

The next assumption that can be improved is the distinction between age groups. By dividing the population into several age groups, more specific knowledge can be obtained about the mentally disabled population and the effect of self-reliance on the number of care requests from the Wlz. This would increase the usefulness of the results from the indication subsystem.

Dividing the population into multiple age groups will also lead to different predictions about the influence of different dimensions of self-sufficiency, the third assumption that could be improved. It is therefore recommended to conduct further research on self-efficacy and the effect of self-efficacy on the care dependency of someone with a low IQ score. With this more detailed information, an improved version of the self-efficacy submodel could be run, which would lead to more realistic results.

The re-evaluation of the assumption leads to another recommendation for future research. With the improved assumptions, the next step of the System Dynamics approach can be carried out. After validating the model with the new assumptions, possible policy interventions in the model can be tested. For policymakers, this means that more concrete recommendations can be made to ensure that the intellectual disability sector can cope with the increasing number of people in need of care.

Another recommendation is to extend the model with the fourth step of the intellectual disability population, designing a care plan, as explained in Appendix B. This study focused on the intellectual disability sector until the point someone receives the indication and compares this with the capacity based on the number of institutional places. However, there are also other options for someone with an intellectual disability indication. Not everyone needs to live in an institution, it is also possible to receive care at home, or partly in an institution, for example. By adding this to the model, a complete overview of the intellectual disability sector is available, and therefore it will be able to look more closely at possible policy interventions. Since this fourth step is also influenced by choice behaviour, it might be more fitted to develop an Agent-Based Model (ABM) for that part of the intellectual disability sector. For future research, these different options should be considered.

An additional note concerning the further exploration of the fourth stage. As was stated in the literature, the movement of 'living at home longer' is an increasingly important theme for the sector (National Health Care Institute, 2015; Staalduinen & Voorde, 2011; Biezen et al., 2022; Brennan et al., 2017). Especially for the population with an IQ score between 70 and 85, the possibility to live at home and receive the need care at home are expanding. During a research on the fourth step, this should be implemented in such a way that the capacity will be better spread amongst the population for which living in an institution is crucial.

A final recommendation would be to ensure that additional records are kept for intellectual disabilities. Care for the intellectually disabled varies from client to client. This makes it difficult to evaluate the sector and make recommendations. When more data is tracked, better models for the sector can be designed and better-aligned policy interventions can be implemented.

8.3.2 Recommendations for policymakers

The findings of this study can help policymakers avoid the vicious cycle of self-efficacy for the mentally disabled sector. Policymakers need to start thinking about possible interventions. Potential interventions could look like this. However, more research is needed to analyse the drawbacks and possible unintended consequences of such measures. The following measures are being considered:

- Low-IQ children who cannot attend a regular school are less self-reliant. Children who attend regular schools can make new friends and learn to be more independent. This will result in fewer minors seeking care from the intellectual disability sector and may even make them more self-reliant as adults. Unfortunately, this is not possible for all children with low IQs, making it even more important to ensure that any new programme focuses on the children's abilities. Possible measures include more flexible rules for schools and more guidelines for schools to guide children with intellectual disabilities.

- Unemployment among adults with low IQ has a major impact on self-sufficiency. Part of this unemployment is caused by the disappearance of simple jobs, due to automation. The impact of work has a positive effect on people with low IQ because these people need daytime activities and a sense of financial independence. Policymakers can therefore implement different options or combinations of options. First, ensuring that enough jobs remain available for this population. Another option is to organise more social activities for this population to participate in. Next, a possible option could be to invest in social services that ensure that these people have day care.

- A person’s social network was also found to be important for self-reliance in the mentally disabled population. For most of these people, meeting new people and maintaining quality relationships is difficult. This is something that can be facilitated by the government and can be combined with the previous recommendation on social agencies and activities for this population.

VGN has already started a programme called "A meaningful life, just participating", in which they highlight, among other things, the importance of education and employment for the population with intellectual disabilities (VGN, 2020). An improved System Dynamics model could test possible policy interventions related to these factors. The results of this policy analysis could support their ideas on improving the factors for the mentally disabled population and strengthen their arguments. This could encourage policymakers to implement new policies for the mentally disabled sector.

9 Conclusion

In this section, the main research question is answered based on the answers to the sub-questions. After the research questions are answered, recommendations are done for policymakers and future research opportunities.

9.1 Answer research questions

In this section, an answer to the main research question is provided, based on the answers to the sub-questions. Before elaborating on the answers, the research questions are repeated.

The main research question of this research was: *"Why is there an increase in demand within the intellectual disability sector in the Netherlands"*
The following sub-questions were used to find an answer:

1. What are the factors causing an increase in care demand in the intellectual disability sector?
2. What were the historical trends in the care demand in the intellectual disability sector in the Netherlands?
3. How are the factors influencing the intellectual disability population connected in the Netherlands?
4. How do the interconnected factors influence the behaviour of the intellectual disability sector in the Netherlands?

9.1.1 Answer sub-questions

What are the factors causing an increase in care demand in the intellectual disability sector? After the literature review, multiple factors were identified to cause an increase in the intellectual disability sector. The factors are divided into three stages of the intellectual disability population and classified based on different sorts of factors, population, social-technical and healthcare sector factors. An overview of the factors can be found in Figure 5.

First the existence of an intellectual disability, only population factors appear, meaning that the factors influence the intellectual disability itself. Epidemiological factors and life expectancy were found to influence the intellectual disability sector. Both these factors are not considered key factors for the increase. Epidemiological factors cause an increase as well as a decrease in the incidence of an intellectual disability. The increase in life expectancy is considered too small to cause a large increase in the intellectual disability population.

In the second stage, the demand for care arises, and socio-technical factors influence the intellectual disability sector. The socio-technical factors influence the socio-technical environment of the intellectual disability sector. One of the factors influencing this sector is technological innovations. Technological innovations bring opportunities as well as limitations for the intellectual disability population and is therefore not considered to be a key factor for the growth of the population. A combined factor for the social network and employment influence is self-reliance. Self-reliance is an increasing problem for the intellectual disability population, caused by, for example, changing norms and values, and a more demanding and complex society. Therefore these are key factors to consider further within this research.

The last researched stage was the stage in which a request for care and support from the intellectual disability sector was done. In this stage, all three categories of factors appear. Multi-morbidity affects the care demand of the intellectual disability population, which can be classified as a population factor. Since this problem mostly occurs once they grow older, this group already has intellectual disability indications, they should only be re-indicated to receive the needed care. For that reason, multi-morbidity is not a key factor. Migration is a socio-technical factor and is not classified as a key factor. An increase in indications granted to people with a migration background was seen. However, it was also found this is a 'catching up' effect and has stabilised over time. The last factor is the healthcare sector institutional changes, which are classified as healthcare sector factors. These factors influence the healthcare sector, which indirectly influences the number of people allowed within the intellectual disability sector. Policy changes can have large influences on the sector, so this is considered a key influence.

To conclude, the factors that were found to have the most influence on the growth of the intellectual disability sector are self-reliance and healthcare sector institutional changes.

What were the historical trends in the care demand in the intellectual disability sector in the Netherlands? After evaluating the data, the most worrisome outcome is the increase in the total intellectual disability population of around 27% from 2015 to 2022. This put a lot of pressure on the sector. This also proves the need to change something within the intellectual disability sector to be able to in some way stop the increase of making sure enough capacity exists for the growing population.

First, new people receive an indication for a specific care profile, or inflow. After an outlier from 2015 to 2017, the inflow shows a relatively stable inflow and follows the same trend for most care profiles. The reason for this outlier is the system change in 2015, which also made it easier for people to switch to a different care profile. The only deviating care profile was VG7. This care profile can also be classified as one of the most difficult care profiles because it has many behavioural problems. In addition, it is possible to get a VG7 indication with severe and mild intellectual disabilities. All this makes VG7 a difficult but interesting care profile. Besides this trend in care profiles, this also indicates that the occurrence of intellectual disability is not the main cause of the increase in the population. This means that epidemiological factors can be ruled out as important factor to consider. Within the inflow trend, what the literature expected was also found, namely that migration was a 'catch-up effect' and therefore can also be ruled out as an important factor to consider.

Another noteworthy trend seen in the data comes from the outflow, in other words, the number of deceased people with an intellectual disability indication. Most of the care profiles show a relatively stable outflow, while it is known that the population is increasing. This means that proportionally fewer people are deceased. Compared to the average age of mortality, which shows a slight increase over the years, it can be stated that people have an increased life expectancy. However, since the difference is not significant, the increase in life expectancy is not the main factor causing the intellectual disability population to increase.

Even though it was not possible to evaluate all the factors found in the literature, based on the lack of available data, the factors that were identified as influential, self-reliance and the healthcare sector institutional changes, were not excluded. Therefore these factors are further evaluated in the modelling phase of this study. All the data from this phase can be used as input data for the modelling phase.

How are the factors influencing the intellectual disability population connected in the Netherlands? In Figure 33, all the connections between the factors identified during the first two phases are shown in a causal loop diagram. Within this conceptual model, the influence of self-reliance was found important, just as indicated during the first sub-question. Three reinforcing feedback loops were identified.

The first reinforcing feedback loop is called *'social network care'*. The social network of someone with a low IQ score is smaller when the self-reliance is lower since people with low self-reliance are less able to attend social events or have the capabilities to develop a relationship with someone. With the changing society, where people live more individualistic life and the demand are higher, the intellectual disability sector will fall behind even more. This is a reinforcing effect because once the self-reliance becomes lower, the smaller the social network becomes, and the lower the self-reliance is again, etc.

The second reinforcing feedback loop is called *'education'*. The ability to attend a regular school will help minors to be more self-reliant. In regular school, children learnt to also perform tasks on their own, make new friends, join in social activities, etc. Leading to higher self-reliance. However, minors with a low IQ are less able to attend regular school because in most cases, specific and individualistic guidance is needed. Meaning that minors with a low IQ in special education, are less likely to meet new friends. This leads, as explained in the previous paragraph to lower self-reliance. Lower self-reliance also leads to more individualistic attention and guidance in school, which means lower self-reliance again leads to fewer minors with a low IQ school in a regular school.

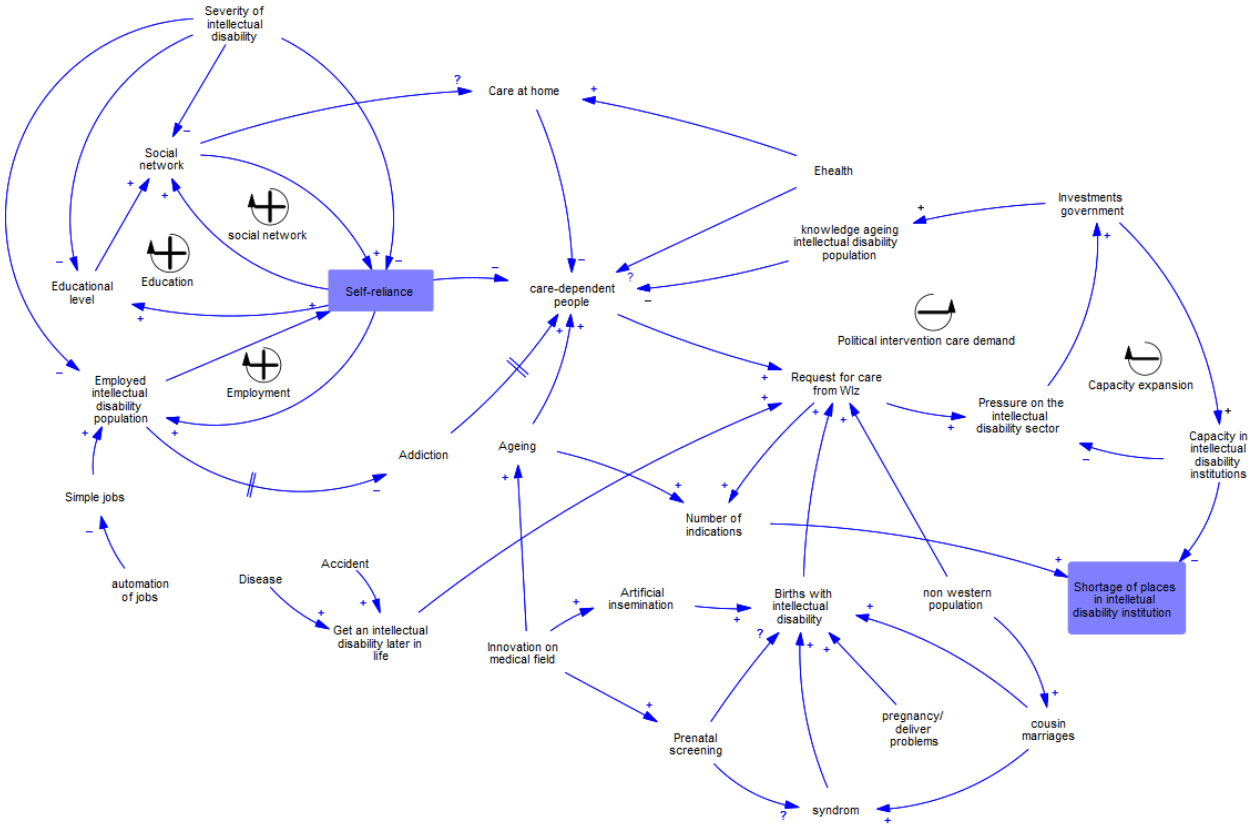


Figure 33: Repetition of initial causal loop diagram of the intellectual disability sector

The third feedback loop that drives systematic behaviour is called *'employment'*. Employment influences self-reliance because someone with a low IQ who is employed is able to financially have more power over their life and they have enough day-time activity to be more self-reliant. However, not the whole population with a low IQ score is able to have a job, the less self-reliant someone is, the less likely it is they have a job. These reinforcing mechanisms will also drive self-reliance to keep declining.

As seen in Figure 33, the healthcare sector institutional changes also show some feedback loops. However, these feedback loops are balancing loops. To better understand the growth of the intellectual disability population, the reinforcing feedback loops around self-reliance are more important to research. Therefore was chosen to focus on the influence of self-reliance on the intellectual disability population.

How do the interconnected factors influence the behaviour of the intellectual disability sector in the Netherlands?
To further examine the behaviour of the three reinforcing feedback loops around self-reliance, a System Dynamics model was developed and tested. Because the System Dynamics contained a lot of assumptions and some sensitivity, the numerical outcomes of the model can not be used to measure the exact impact of self-reliance on the intellectual disability sector. However, the behavioural changes of the mechanisms gave some first hints to the influence of self-reliance.

It was found that the reinforcing feedback loop did harm the intellectual disability sector, meaning the number of people applying for care increased a lot. Especially factors influencing the self-reliance of adults and the population with an IQ score between 70 and 85 can have a major influence on the number of people applying for care. This leads to increased pressure on the sector, in terms of a large shortage in the number of institutional places for the intellectual disability population.

9.1.2 Answer main research question

The question of why there is an increase in the intellectual disability population has been attempted to be answered within this study. After evaluating multiple factors as a cause for the growth in the intellectual disability population, self-reliance was selected as being an important factor. In the conceptual model, three reinforcing feedback loops were found, indicating that when there is no intervention, the self-reliance of the intellectual disability population continuously decreases, resulting in more people applying for care from the Wlz. In the qualitative model, this proposition could not be rejected, indicating the importance of the role of self-reliance on the growth of the intellectual disability population. Especially for the population with an IQ score between 70 and 85, more attention should be paid to the increase or maintaining of self-reliance. In that way, the intellectual disability sector is always able to care for the ones who cannot live without.

An important note to consider is that an indication for the intellectual disability sector is granted for life. Meaning someone will always allowed and will receive care. Since people grow accustomed to the received care, getting more self-reliant ones the indication has been given will be very hard. This makes it even more important to make sure policy intervention focus on the group of people with a low IQ score, before they apply for care. In the end, this could help the sector providing care to the people who really need it.

9.2 Relevance of the research

9.2.1 Scientific relevance

This model was different compared to other models within the field because System Dynamic models are rare and typically focus on the optimisation of resources, such as institutions and personnel, of the intellectual disability sector (Duryan, Nikolik, van Merode, & Curfs, 2014, 2012). The first difference is the attempt to capture the long-term effects of losing or developing self-reliance for the intellectual disability population. This was linked to the capacity of the intellectual disability sector to be able to give insights into the possible shortage/surplus in institutions. Simulation of these long-term learning effects in the field of the intellectual disability sector is novel. This research counts as a first step in understanding this effect and improving the sector.

Second, my model tried to get a better understanding of the growth of the intellectual disability population. Trying to capture this reason increases the chance to guide the population with a low IQ score before entering the intellectual disability sector. This, in the end, will lead to fewer people applying for care. Capturing the change of the intellectual disability population has not been done before. This research gave a clear understanding of the factors influencing the population and researched one of the most important factors.

Another contribution is that System Dynamics can be used as a good communication tool within the sector. Based on the System Dynamic model, relations can be explained and further explored, consequences are visible and possible solutions can be tested. Unfortunately the last was not done within this research. By improving the model, a good follow-up step can be taken. The System Dynamics model was the basis of the conversation with the CIZ. Although the assumptions were not completely fitted, they saw the power of the model for an improved sector.

The next contribution is the holistic approach of the system. This gave me the opportunity to discover the mechanisms that were causing undesirable system behaviour. An example of undesirable behaviour that was found was the self-reliance loop. This loop was identified within the conceptual model and tested in the quantified model. This loop caused the whole system to change negatively and proved something has to be done.

9.2.2 Societal relevance

In the Netherlands, there are 2.2 million people with an IQ score between 70 and 85 (VGN, 2018b). A large part of this group is self-reliant, meaning they can live a relatively 'normal' life, with just a little guidance. They will be employed, and friends and family will guide them and other social activities to go to. However, due to changing society and technological improvement, this group will lose some of this self-reliance. Resulting in an increased need for care and support and a higher chance this needs to be provided by the healthcare system. Since there is another group, with an IQ score below 70, who cannot live without care, the people with an IQ score between 70 and 85 mustn't need to fall back on the intellectual disability sector (Ras et al., 2010).

This research will look into the influence of the self-reliance of the intellectual disability population on the number of people who will depend on care from the intellectual disability sector. With the developed model, several policy interventions can be tested to make sure the intellectual disability is able to cope with the increasing number of people with an intellectual disability.

9.2.3 Relevance for Engineering and Policy Analysis

What makes a thesis an EPA thesis? According to Enserink (2017), the designer and developer of the EPA curriculum, an EPA thesis should research a topic related to one or several grand challenges, and it should focus on a situation where policies are failing or need to be designed. This research is about the grand challenge of healthcare. Like in Sustainable Development Goal 3: Good Health and Well-being, with the main target to ensure healthy lives and promote well-being for all at all ages (United Nations, n.d.). It is also a fitting EPA Thesis because big amounts of data will be used for the research and a simulation model will be built, specifically a System Dynamics model. One of the learning lines is the modelling and simulation line, which includes learning how to build and work with such simulation models (TU Delft, n.d.). For this research knowledge from different courses will be used, like *Introduction to Data Science*, *Model-based decision making*, and *Advanced System Dynamics*.

References

Acharya, K. (2012). Prenatal testing for intellectual disability: Misperceptions and reality with lessons from down syndrome. *Development Disabilities Research Reviews*, *17*(1), 27- 31. doi: https://doi.org/10.1002/ddrr.135

administrative office, H. (n.d.). *Leveringsvormen langdurige zorg (wlz).* Retrieved from https://zorgkantoor.nl/langdurige-zorg-organiseren/leveringsvormen-langdurige-zorg-wlz

Alzheimercentrum Amsterdam. (n.d.). *Ziekte van alzheimer.* Retrieved from https://www.alzheimercentrum.nl/dementie/vormen-van-dementie/de-ziekte-van-alzheimer/

American Psychiatric Association. (n.d.). *What is intellectual disability?* Retrieved from https://www.psychiatry.org/patients-families/intellectual-disability/what-is-intellectual-disability

Authority, D. H. (2020). *Monitor zicht op gehandicaptenzorg 2020* (Tech. Rep.). Retrieved from https://puc.overheid.nl/nza/doc/PUC_308164_22/1/

Benders, L., & Merkus, J. (2020). *Destep-analyse van de externe omgeving.* Retrieved from https://www.scribbr.nl/modellen/destep-analyse/

Biezen, M. V. D., Glind, I. V. D., Ven, G. V. D., Andriessen, P., Rooij, J. V., & Westerbeek, A. (2022). *Trendanalyse verstandelijk gehandicaptenzorg* (Tech. Rep.). FWG. Retrieved from https://fwg.nl/app/uploads/2022/03/FWG-Trendrapport-Gehandicaptenzorg-2022-V-17-3.pdf?utm_source=Downloadknop+NIEUW+2&utm_medium=TR+GHZ+2022&utm_campaign=download+pagina&utm_id=FWG+Trendrapport+GHZ+2022

Bigby, C. (2009). Beset by obstacles: A review of australian policy development to support ageing in place for people with intellectual disability. *Journal of Intellectual & Developmental Disability*, *33*(1), 76-86. doi: 10.1080/13668250701852433

Boezaard, Haitsma, & Nieuwenhuis. (2018). *School en vriendschappen* (Tech. Rep.). Ieder(in), MIND Landelijk Platform Psychische Gezondheid en de Patiëntenfederatie Nederland. Retrieved from https://www.patientenfederatie.nl/downloads/rapporten/474-school-en-vriendschappen/file

Boonman, A. J., Cuypers, M., Leusink, G. L., Naaldenberg, J., & Bloemendal, H. J. (2022). Cancer treatment and decision making in individuals with intellectual disabilities: a scoping literature review. *The Lancet Oncology*, *23*(4), 174-183. doi: https://doi.org/10.1016/S1470-2045(21)00694-X

Brennan, D., McCausland, D., O'Donovan, M. A., Eustace-Cook, J., McCallion, P., & McCarron, M. (2020). Approaches to and outcomes of future planning for family carers of adults with an intellectual disability: A systematic review. *Journal of Applied Research in Intellectual disabilities*, *33*, 1221-1233. doi: 10.1111/jar.12742

Brennan, D., Murphy, R., McCallion, P., & McCarron, M. (2017). "what's going to happen when we're gone?" family caregiving capacity for older people with an intellectual disability in ireland. *Journal of Applied Research in Intellectual disabilities*, *31*, 226-235. doi: 10.1111/jar.12379

Care House. (n.d.). *(licht) verstandelijke beperking.* Retrieved from https://www.carehouse.nl/hulpgebieden/licht-verstandelijke-beperking#:~:text=Voor%20een%20verstandelijke%20beperking%20is,sociale%20vaardigheden%20aanwezig%20te%20zijn.

CBS. (2015). *Bevolking op 1 januari en gemiddeld; geslacht, leeftijd en regio.* Retrieved from https://opendata.cbs.nl/#/CBS/nl/dataset/03759ned/table?dl=39E0B

CBS. (2017). *Vruchtbaarheid aan het begin van de 21e eeuw.* Retrieved from https://www.cbs.nl/-/media/_pdf/2017/51/2017st08-vruchtbaarheid-21e-eeuw.pdf

CBS. (2020). *Kerncijfers geboorte; waarneming en prognose, geboortegeneratie.* Retrieved from https://www.cbs.nl/nl-nl/cijfers/detail/84878NED?dl=4BB03

CBS. (2021a). *Kinderen krijgen.* Retrieved from https://www.cbs.nl/nl-nl/visualisaties/dashboard-bevolking/levensloop/kinderen-krijgen#:~:text=Sinds%20de%20jaren%20zeventig%20is,3%20jaar%20hun%20tweede%20kind.

CBS. (2021b). *Maatwerktabellen ontwikkeling vg 2015-2020.*

CBS. (2022). *Levensverwachting; geslacht, leeftijd (per jaar en periode van vijf jaren).* Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/37360ned/table?fromstatweb

CBS. (2023). *Personen met gebruik wlz-zorg; leveringsvorm, zorgzwaartepakket.* Retrieved from https://mlzopendata.cbs.nl/#/MLZ/nl/dataset/40065NED/table?ts=1675860409972

CIZ. (n.d.-a). (Tech. Rep.). Author.

CIZ. (n.d.-b). *Wat is de wet langdurige zorg?* Retrieved from https://www.ciz.nl/client/wat-is-de-wlz

CIZ. (n.d.-c). *Wlz.* Retrieved from https://ciz.nl/client/ik-wil-een-aanvraag-doen/wlz

CIZ. (2020). *Aanspraak zorgprofielen (vg).* Retrieved from https://ciz.databank.nl/jive

CIZ. (2023). *Aanspraken - nederland.* Retrieved from https://ciz.databank.nl/jive

Cuypers, M., Schalk, B. W. M., Boonman, A. J. N., Naaldenberg, J., & Leusink, G. L. (2022). Cancer-related mortality among people with intellectual disabilities: A nationwide population-based cohort study. *Cancer*, *128*(6), 1267-1274. doi: 10.1002/cncr.34030

De Winter, C., Bastiaanse, L., Hilgenkamp, T., Evenhuis, H., & Echteld, M. (2012). Overweight and obesity in older people with intellectual disability. *Research in Developmental Disabilities*, *33*(2), 398-405. doi: https://doi.org/10.1016/j.ridd.2011.09.022

Dillane, I., & Doody, O. (2019). Nursing people with intellectual disability and dementia experiencing pain: An integrative review. *Journal of Clinical Nursing*, *28*, 2472-2485. doi: https://doi.org/10.1111/jocn.14834

DisabledNL. (n.d.-a). *Wat is een verstandelijke beperking.* Retrieved from https://handicap.nl/wat-is-een-verstandelijke-beperking/

DisabledNL. (n.d.-b). *Wat is het syndroom van down?* Retrieved from https://handicap.nl/syndroom-van-down/

Doody, C., Markey, K., & Doody, O. (2012). Health of ageing people with intellectual disability and the role of the nurse in ireland. *Journal of Intellectual Disabilities*, *16*. doi: 10.1177/1744629512462181

Dowse, L. (2009). 'some people are never going to be able to do that'. challenges for people with intellectual disability in the 21st century. *Disability Society*, *24*(5), 571-584. doi: https://doi.org/10.1080/09687590903010933

Duryan, M., Nikolik, D., van Merode, G., & Curfs, L. (2012). System dynamics modeling for intellectual disability services: A case study. *Journal of Policy and Practice in Intellectual Disabilities*, *9*(2), 112-119. doi: https://doi.org/10.1111/j.1741-1130.2012.00342.x

Duryan, M., Nikolik, D., van Merode, G., & Curfs, L. M. G. (2014). Using cognitive mapping and qualitative system dynamics to support decision making in intellectual disability care. *Journal of Policy and Practice in Intellectual Disabilities*, *11*(4), 245-254. doi: https://doi.org/10.1111/jppi.12095

Eelants, M. (n.d.). *Destep-analyse.* Retrieved from https://www.marketingmodellen.com/destep-analyse/

Eggink, E., Woittiez, I., & Klerk, M. D. (2020). *Maatwerk in meedoen* (Tech. Rep.). SCP. Retrieved from https://www.scp.nl/binaries/scp/documenten/publicaties/2020/12/03/maatwerk-in-meedoen/Maatwerk+in+meedoen_def.pdf

Enserink, B. (2017). *What makes your thesis an epa thesis?* Retrieved from https://www.youtube.com/watch?v=0qndV2X5_yo

Evenhuis, H. M. (2011). *Gezondheid van ouderen met verstandelijke handicaps.* Retrieved from https://www.ntvg.nl/artikelen/gezondheid-van-ouderen-met-verstandelijke-handicaps

Evenhuis, H. M. (2014). *Gezond ouder met een verstandelijke beperking* (Tech. Rep.). GOUD. Retrieved from https://www.kennispleingehandicaptensector.nl/images/KGS/images/Nieuws/Rapport-GOUD2014-def.pdf

Forrester, J. W. (1995). *The beginning of system dynamics*.

Forrester, J. W., & Senge, P. M. (1980). Tests for building confidence in system dynamics models. *TIMS Studies in the Management Science*, 209-2028.

García-Domínguez, L., Navas, P., Ángel Verdugo, M., & Arias, V. B. (2020). Chronic health conditions in aging individuals with intellectual disabilities. *International Journal of Environmental Research and Public Health*, *17*. doi: https://doi.org/10.3390/ijerph17093126

GGZStandards. (2018). *Psychische stoornissen en zb/lvb.* Retrieved from https://www.ggzstandaarden.nl/generieke-modules/psychische-stoornissen-en-zwakbegaafdheid-zb-of-lichte-verstandelijke-beperking-lvb/introductie

Goed vertegenwoordigd. (n.d.). *Mensen met een verstandelijke beperking.* Retrieved from https://www.goedvertegenwoordigd.nl/kennisbank/voor-wie-2/verstandelijke-beperking/

Gommans, T., & Offringa, S. (2022). *Ontwikkeling indicaties vg wlz* (Tech. Rep.). Rebel. Retrieved from https://capaciteitsorgaan.nl/app/uploads/2022/07/2022-03-31-Rebel-ontwikkeling-VG-2015-2020-DEF.pdf

Hoekstra, A., Bakker, F., & Ven, L. G.-V. D. (2018). Ouderen met een verstandelijke beperking en gelukkig oud worden. *Geron*, *20*(4), 53-55. doi: 10.1007/s40718-018-0184-0

Hsieh, K., Rimmer, J. H., & Heller, T. (2013). Obesity and associated factors in adults with intellectual disability. *Journal of Intellectual Disability Research*, *58*, 851-863. doi: https://doi.org/10.12968/bjon.2012.21.8.460

Jackson, R. (2017). Politics and intellectual disability in england: an historical perspective. *International Journal of Developmental Disabilities*, *63*(1), 52-58. doi: 10.1080/20473869.2015.1107364

Kaldenbach, Y. (2015). *Whitepaper dsm-5* (Tech. Rep.). Retrieved from https://www.boompsychologie.nl/media/15/dsm-5_whitepaper_yaron_kaldenbach_verstandelijke_beperking.pdf

Krause, S., Ware, R., McPherson, L., Lennox, N., & O'Callaghan, M. (2016). Obesity in adolescents with intellectual disability: Prevalence and associated characteristics. *Obesity Research Clinical Practice*, *10*, 520-530. doi: https://doi.org/10.1016/j.orcp.2015.10.006

Kuppermann, M., Nakagawa, S., Cohen, S. R., Dominguez-Pareto, I., & dn Susan D. Holloway, B. L. S. (2011). Attitudes toward prenatal testing and pregnancy termination among a diverse population of parents of children with intellectual disabilities. *Prenatal Diagnoses*, *31*(13), 1251-1258. doi: https://doi.org/10.1002/pd.2880

Leeuw, M. J. D., Oppewal, A., Elbers, R. G., Knulst, M. W. E. J., Maurik, M. C. V., Bruggen, M. C. V., ... Maes-Festen, D. A. M. (2022). Healthy ageing and intellectual disability study: summary of findings and the protocol for the 10-year follow-up study. *BMJ Open*, *12*. doi: 10.1136/bmjopen-2021-053499

Liao, P., Vajdic, C., Trollor, J., & Reppermund, S. (2021). Prevalence and incidence of physical health conditions in people with intellectual disability - a systematic review. *PloS one*, *16*. doi: 10.1371/journal.pone.0256294

Lin, J., Lin, L., & Hsu, S. (2016). Aging people with intellectual disabilities: Current challenges and effective interventions. *Review Journal of Autism and Developmental Disorders*, *3*, 266–272. doi: https://doi.org/10.1007/s40489-016-0082-0

Marian Maaskant. (2018). *Mortaliteit en verstandelijke beperkingen.* Retrieved from https://www.kennispleingehandicaptensector.nl/gehandicaptensector/media/documents/Thema's/Palliatieve%20zorg/levensverwachting-verstandelijke-beperking-marian-maaskant.pdf

Marriott, A., & Robertson, J. (2014). *Making reasonable adjustments to epilepsy services for people with learning disabilities* (Tech. Rep.). Public Health England. Retrieved from https://www.ndti.org.uk/resources/making-reasonable-adjustments-to-epilepsy-services-for-people-with-learning

Martinez, I. J., & Richardson, G. P. (2011). *Best practices in system dynamics modeling.* Retrieved from https://proceedings.systemdynamics.org/2001/papers/Martinez_1.pdf

McGuire, B. E., Whyte, N., & Hardardottir, D. (2006). Alzheimer's disease in down syndrome and intellectual disability: A systematic review. *The Irish Journal of Psychology*, *27*.

Ministry of Health, Welfare and Sport. (n.d.-a). *Extra budget en maatwerk in de wlz.* Retrieved from https://www.regelhulp.nl/onderwerpen/wlz/extra-budget

Ministry of Health, Welfare and Sport. (n.d.-b). *Kan ik zorg vanuit de wet langdurige zorg (wlz) ook thuis krijgen?* Retrieved from https://www.rijksoverheid.nl/onderwerpen/verpleeghuizen-en-zorginstellingen/vraag-en-antwoord/zorg-thuis-krijgen-via-wet-langdurige-zorg

Ministry of Health, Welfare and Sport. (n.d.-c). *modulair pakket thuis (mpt).* Retrieved from https://www.regelhulp.nl/onderwerpen/m/modulair-pakket-thuis-mpt

Ministry of Health, Welfare and Sport. (n.d.-d). *volledig pakket thuis (vpt).* Retrieved from https://www.regelhulp.nl/onderwerpen/v/volledig-pakket-thuis

Ministry of Health, Welfare and Sport. (n.d.-e). *Wat is het verschil tussen een persoonsgebonden budget (pgb) en zorg in natura?* Retrieved from https://www.rijksoverheid.nl/onderwerpen/persoonsgebonden-budget-pgb/vraag-en-antwoord/verschil-pgb-zorg-natura

Ministry of Health, Welfare and Sport. (n.d.-f). *Wat staat er in een zorgplan of zorgleefplan?* Retrieved from https://www.rijksoverheid.nl/onderwerpen/verpleeghuizen-en-zorginstellingen/vraag-en-antwoord/zorgplan-of-zorgleefplan#:~:text=Zorgplan%20maken,En%20uw%20mogelijkheden%20en%20beperkingen.

Ministry of Health, Welfare and Sport. (n.d.-g). *Welke zorg kan ik krijgen vanuit de wet langdurige zorg (wlz)?* Retrieved from https://www.rijksoverheid.nl/onderwerpen/verpleeghuizen-en-zorginstellingen/vraag-en-antwoord/zorg-via-wet-langdurige-zorg

Ministry of Health, Welfare and Sport. (n.d.-h). *Wonen in een instelling voor mensen met een verstandelijke beperking.* Retrieved from https://www.regelhulp.nl/onderwerpen/verstandelijke-beperking/vb-instelling

Ministry of Health, Welfare and Sport. (n.d.-i). *Zorgprofiel.* Retrieved from https://www.regelhulp.nl/onderwerpen/wlz/zorgprofiel

Ministry of Health, Welfare and Sport. (2017). *Groei in de langdurige verstandelijk gehandicaptenzorg* (Tech. Rep.). Rebel. Retrieved from https://www.vgn.nl/system/files/article/file/groei-in-de-langdurige-verstandelijk-gehandicaptenzorg.pdf

Ministry of Health, Welfare and Sport. (2022). *Regeling langdurige zorg.* (https://wetten.overheid.nl/BWBR0036014/2022-04-15/0#BijlageA)

National centre of expertise. (n.d.). *Onderwijs lvb.* Retrieved from https://www.kenniscentrumlvb.nl/onderwijs-lvb/

National Health Care Institute. (n.d.-a). *Toegang tot wlz zorg.* Retrieved from https://www.zorginstituutnederland.nl/Verzekerde+zorg/toegang-tot-wlz-zorg

National Health Care Institute. (n.d.-b). *Wlz-algemeen: Hoe werkt de wet langdurige zorg?* Retrieved from https://www.zorginstituutnederland.nl/Verzekerde+zorg/wlz-algemeen-hoe-werkt-de-wet-langdurige-zorg#:~:text=De%20Wet%20langdurige%20zorg%20(Wlz,niet%20alleen%20kan%20worden%20gelaten.

National Health Care Institute. (2015). *Overgangsrechts (wlz).* Retrieved from https://www.zorginstituutnederland.nl/Verzekerde+zorg/overgangsrecht-wlz

Netherlands Court of Audit. (2018). *Focus op toegang tot de wet langdurige zorg* (Tech. Rep.). Netherlands Court of Audit. Retrieved from https://www.rekenkamer.nl/binaries/rekenkamer/documenten/rapporten/2018/06/06/focus-op-toegang-tot-de-wet-langdurig-zorg/Focus+op+Toegang+tot+de+Wet+Wlz+WR.pdf

Prinsen Stichting. (n.d.). *Niveaus en syndromen.* Retrieved from https://www.prinsenstichting.nl/ori%C3%ABnteren/niveaus-en-syndromen/

Pruyt, E. (2013). *Small system dynamics models for big issues: Triple jump towards real-world complexity*. Delft: TU Delft Library. Retrieved from https://simulation.tudelft.nl/SD/CaseBookSD101ErikPruyt_2019a.pdf

Ras, M., Woittiez, I., Kempen, H. V., & Sadiraj, K. (2010). *Steeds meer verstandelijk gehandicapten?* (Tech. Rep.). SCP. Retrieved from https://repository.scp.nl/bitstream/handle/publications/768/Steeds%20meer%20verstandelijk%20gehandicapten_Drukker.pdf?sequence=1&isAllowed=y

Robertson, J., Hatton, C., Emerson, E., & Baines, S. (2015). Prevalence of epilepsy among people with intellectual disabilities: A systematic review. *Seizure*, *29*, 46-62. doi: 10.1016/j.seizure.2015.03.016

Sheeha, R., Ali, A., & Hassiotis, A. (2014). Dementia in intellectual disability. *CO Psychiatry*, *27*, 143-148. doi: 10.1097/YCO.0000000000000032

Staalduinen, W. V., & Voorde, F. T. (2011). *Trendanalyse verstandelijk gehandicaptenzorg* (Tech. Rep.). TNO. Retrieved from https://www.tno.nl/media/2162/trendanalyse_verstandelijk_gehandicaptenzorg.pdf

Sterman, J. D. (2001). System dynamics modeling: Tools for learning in a complex world. *California Management Review*, *43*(4), 8-25. doi: 10.1109/EMR.2002.1022404

Strydom, A., Hassiotis, A., King, M., & Livingston, G. (2009). The relationship of dementia prevalence in older adults with intellectual disability (id) to age and severity of id a systematic review. *The Irish Journal of Psychology*, *39*, 13-21. doi: 10.1017/S0033291708003334

Strydom, A., Shooshtari, S., Lee, L., Raykar, V., JennyTorr, Tsiouris, J., ... Maaskant, M. (2010). Dementia in older adults with intellectual disabilities — epidemiology, presentation, and diagnosis: A systematic review. *Journal of Policy and Practice in Intellectual Disabilities*, *7*.

TU Delft. (n.d.). *Programme structure.* Retrieved from https://www.tudelft.nl/onderwijs/opleidingen/masters/epa/msc-engineering-and-policy-analysis/programme/programme-structure

United Nations. (n.d.). *Targets and indicators.* Retrieved from https://sdgs.un.org/goals/goal3

VGN. (2017). *Arbeidsmarkt in de gehandicaptenzorg onder druk.* Retrieved from https://www.vgn.nl/nieuws/arbeidsmarkt-de-gehandicaptenzorg-onder-druk

VGN. (2018a). *Beperking of niet, ieder kind heeft het recht om te leren.* Retrieved from https://www.vgn.nl/nieuws/beperking-niet-ieder-kind-heeft-het-recht-om-te-leren

VGN. (2018b). *De gehandicaptenzorg in cijfers.* Retrieved from https://www.vgn.nl/feiten-en-cijfers-de-gehandicaptenzorg

VGN. (2020). *Visiedocument 2030.* Retrieved from https://www.vgn.nl/system/files/2022-08/Visie2030%20-%20visiedocument%20voor%20de%20gehandicaptenzorg%20.pdf

Woittiez, I., Egging, E., & Ras, M. (2019). *Het aantal mensen met een licht verstandelijke beperking: een schatting* (Tech. Rep.). SCP. Retrieved from https://www.scp.nl/binaries/scp/documenten/publicaties/2019/10/01/het-aantal-mensen-met-een-licht-verstandelijke-beperking-een-schatting/Notitie+Het+aantal+mensen+met+een+lichte+verstandelijke+beperking+-+een+schatting+%28bronbestand%29.pdf

Woittiez, I., Eggink, E., Putman, L., & Ras, M. (2018). *An international comparison of care for people with intellectual disabilities* (Tech. Rep.). SCP. Retrieved from https://www.scp.nl/binaries/scp/documenten/publicaties/2018/07/06/an-international-comparison-of-care-for-people-with-intellectual-disabilities/An+international+comparison+of+care+for+people+with+intellectual+disabillities.pdf

A Intellectual disability sector, the different care profiles

The information for this table comes from the 'Regulation Long-term Care' (Ministry of Health, Welfare and Sport, 2022)

Table 4: Care Profiles in the Netherlands

Care profile	**Information**	**Social Competence**	**Psychosocial/ cognitive function**	**General Daily Living Operations**	**Mobility**	**Nursing**	**Behavioural problems**
VG3	The guidance is focussed on participating in social life and on directing one's own life	Support is needed. For complex daily tasks, a takeover is needed.	Sometimes supervision and control are needed, especially with concentration, memory and thinking	Regular supervision and stimulation are needed. Require help with minor grooming tasks, personal care of teeth, hair, nails, skin and washing.	In fixed familiar surroundings, the client can orient themselves	-	Not or barely
VG4	The guidance is focussed on providing a safe and trusting living and working environment	Support and takeover are needed. The support focuses both on self-reliance in performing tasks and on directing one's own life	Support, guidance or control needed. Orientation with respect to space and persons is limited to the environment and persons are known to the client.	Guidance and help are needed when eating and drinking. A takeover is needed with minor grooming tasks, like care for teeth, hair, nails and skin.	Some help for moving outdoors.	-	Not or barely
VG5	The constant guidance has a structure-providing character, with a clear daily schedule, fixed living rules and strict agreements.	Clients need to take over maintaining social relationships, participating in social life, performing tasks and arranging daily routines.	Support, guidance or control needed. There is focused supervision with the goal of establishing a permanent home base that provides safety and security	Help and takeover needed. The guidance focuses on maintaining the client's abilities. When eating and drinking, help and stimulation are often sufficient	Some help for outside	Possible specific nursing operations related to various conditions are required	To a small extent behavioural problems. counselling focuses particularly on preventing compulsive or manipulative behaviour

VG6	Guidance is often individual and structure-building, aimed at regulating behavioural problems and providing safety	Need assistance or takeover of tasks with respect to most aspects, especially with complex tasks, arranging daily routine and domestic life	Support, guidance and control needed, especially in the areas of concentration, memory and thinking.	Mostly do it yourself, but someone else must oversee or encourage or sometimes help	Usually no assistance needed, sometimes supervision and stimulation in moving outdoors	-	Structural, often cumulative behavioural problems. As a result, clients often or continuously need help, supervision, or direction. There are also frequent psychiatric problems, both active and passive in nature
VG7	This profile can be with a light ID and a severe ID. Both client groups function socially limited/ barely independent and are in need of intensive guidance, due to an ID combined with behavioural and/or psychiatric problems. Clients need constant structure, safety and protection. There is high-risk behaviour, and social problem behaviour and clients are often not self-motivated for treatment	Clients need assistance or takeover of tasks, in part because of a combination of interacting problems. Participation in social life is possible only with individual guidance	Often with continuous help, supervision or direction needed. Particularly in the areas of concentration, memory and thinking	For a light ID: Mostly perform on their own, but often need supervision and stimulation. For severe ID: Do need regular help, especially with minor care tasks, personal care of teeth, hair, nails and home, washing and eating and drinking. 2 caregivers/escorts may be needed	For a light ID: Usually no assistance needed, sometimes supervision and stimulation in moving outdoors. For severe ID: Guidance is needed. This may be variable in intensity. Assistance is particularly needed with orientation in space and moving outside the home	For a severe ID there is possible some nursing is needed.	Various forms of extreme behavioural problems. This can manifest itself in many ways, e.g. verbally aggressive, physically aggressive, destructive, manipulative, compulsive, uncontrolled and reactive behaviour. In addition, self-injurious and self-damaging behaviour is also to be expected. Psychiatric problems frequently occur in these clients. These may be active, passive or variable in nature. Usually a CEP score of 3 or higher and the presence of a Special Care Plan CCE

VG8	Multiple disabled clients do not function independently socially and are in constant need of supervision due to intellectual disability. The clients also have physical disabilities. Participation in social life is possible only with individual supervision.	Takeover of care is needed, such as maintaining social relationships, participation in social life, communication, performing tasks and arranging daily routine.	Sometimes takeover and sometimes help is needed. There is focused on guidance with the goal of achieving a permanent home base that provides safety and security.	Takeover of care needed. With some clients, the deployment of 2 caregivers/supervisors is required to perform care.	Readmission is necessary. Clients are not mobile, both indoors and outdoors, clients are completely dependent on a wheelchair, environmental controls and assistive devices	Regular specific nursing practice related to various conditions	Not or barely

B Stage 4

Together with the healthcare office in the residential area of the client, the right combination of care is determined. Next to medical care, someone with an intellectual disability also requires other support, like personal care, nursing, mobility assistance, daytime activities, and other resources, like a wheelchair or medication (Ministry of Health, Welfare and Sport, n.d.-g). The intellectual disability population has different options regarding how and where to receive care. An overview of the different options is visualised in figure 34. In this figure, the different living options are visualised, including how these options will be provided. These are discussed further. The three options are *'zorg in natura'*, *'personal budget'* or a combination of the two (administrative office, n.d.).

1. *'Zorg in natura'* means the municipality, healthcare office or healthcare insurer determines which healthcare organisations you can choose from (Ministry of Health, Welfare and Sport, n.d.-e). An agreement will be drawn which shows how the care will be provided and by whom. 45% of the intellectual disability population chooses 'zorg in natura' (Authority, 2020).

2. A *'personal budget'* means you can determine when, where and by whom the care and support will be provided yourself (Ministry of Health, Welfare and Sport, n.d.-e). A personal budget contains a certain amount of money, with which you can 'buy' the needed care and support. 27% is choosing the personal budget (Authority, 2020).

3. A combination of these two forms is also possible when different types of care are needed or changes from one form to the other (Ministry of Health, Welfare and Sport, n.d.-e), which is chosen by 26% of the Intellectual Disability population (Authority, 2020).

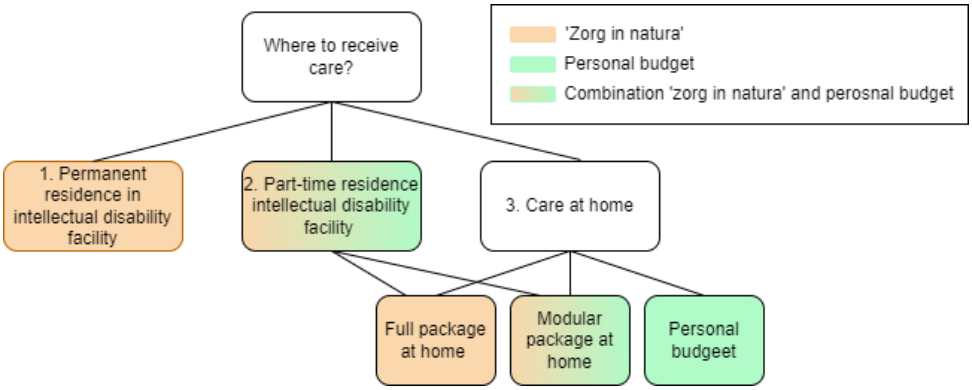


Figure 34: Overview of where to the intellectual disability population can receive care and in which form

Next to the different care-providing forms in the Wlz, there are also different places where someone can receive care:

1. Permanent care in an intellectual disability facility. Whether it is an option to stay part-time in the healthcare facility is based on the severity of the intellectual disability (Ministry of Health, Welfare and Sport, n.d.-h). There are special intellectual disability institutions, but there are also smaller complexes within a neighbourhood where people with intellectual disabilities can live.

2. Part-time residence in an intellectual disability facility. Part-time residence means that at least 7, 8 or 9 of the 14 days someone with an intellectual disability lives in an institution and the other days at home. For the days the patient is living at home, a modular package at home or a personal budget is used. BRON

3. Care at home

   (a) Full package at home. A full package at home means all the care is provided by one healthcare provider, and includes medical and personal care, meals, domestic help, daytime activities and mobility support (Ministry of Health, Welfare and Sport, n.d.-d).

(b) Modular package at home. A modular package at home indicates different healthcare providers provide the care (Ministry of Health, Welfare and Sport, n.d.-c). This package excludes meals and is partly financially covered by the health administration office and partly by the personal budget of the patient.

(c) Personal budget. When there is chosen to arrange all the care by the patient and their family, the personal budget is used. This personal budget is, as mentioned earlier, a specific budget with which care can be 'purchased' with different healthcare providers (Ministry of Health, Welfare and Sport, n.d.-b). It is possible to enlarge this budget when more specific care is needed (Ministry of Health, Welfare and Sport, n.d.-a).

Together with the healthcare office, all the different options to receive the care will be explored (Ministry of Health, Welfare and Sport, n.d.-f). Based on the care and support needs and the indication, the final decision will be made. This will all be put in the personal care plan of the Intellectual Disability client. It is possible to switch to another form of receiving care later, but this has to be done with the healthcare office again.

C Overview of used literature

C.1 Stage 1 literature

Table 5: Literature for factors of stage 1

Factor	Authors	Year	Main findings
Epidemiologic factor	Staalduinen and Voorde	(2011)	Improvements in the medical care, like prenatal screening and artificial insemination, the incidence of people born with an intellectual disability is changing.
	Ras et al.	(2010)	Incidence in changing due to medical improvements. They also found that due to cousins' marriages, the chance of being born with an intellectual disability is increasing.
	Kuppermann et al.	(2011)	Prenatal testing will not always cause a decrease in the number of babies born with an intellectual disability. Part of the woman does not want the prenatal screening because they are scared it will harm the baby or they think that you should just have the baby without it being completely screened.
	Acharya	(2012)	Prenatal testing will not always cause a decrease in the number of babies born with an intellectual disability. There are also women who do prenatal screens but decide to keep the baby even though it might have an intellectual disability. They think it is good to be prepared for whatever is coming.
Life expectancy	Lin et al.	(2016)	Ageing is visible in the intellectual disability population, just like in the rest of the population.
	Doody et al.	(2012)	Ageing is visible in the intellectual disability population, just like in the rest of the population. This research found there is too often a general assumption made that physical decline or poor health in intellectual disability population is due to the impact of 'ageing.' As a consequence, some medical conditions will not be found and/or treated within this population.
	Evenhuis	(2011)	The reason for the increase in life expectancy is the improvement of care and treatment. Due to the increase in life expectancy, the total intellectual disability population is expanding. A consequence of the increase in life expectancy is that age-related vulnerability arises earlier for the ID population.
	Biezen et al.	(2022)	The ageing ID client demand new medical knowledge and skills. Ageing causes an increase in somatic complaints, like diabetes, swallowing problems, problems seeing and hearing and less mobility.

	Staalduinen and Voorde	(2011)	Ageing is visible in the intellectual disability population, just like in the rest of the population. Caretakers of this population need to be prepared for the changing care needs of this sector. Due to the ageing of the ID population, their average mobility will decrease, the care intensity increase and their living arrangements possibly need to be adjusted.
	Gommans and Offringa	(2022)	Due to the increase in life expectancy, more care will be needed because this part of the ID population is more vulnerable. The increase in intellectual disability population due to ageing can have two reasons. It is possible that the inflow to the Wlz can be very big in a certain year and that this group will stay in the Wlz longer than in the past. The other reason is that the age of death will be later. The average life expectancy of the ID population in the Netherlands was 63 years in 2020. However, the amount of people within the ID population of 70 years and older is increasing.
	García-Domínguez et al.	(2020)	The life expectancy of the intellectual disability population has increased over the years. However, there is little evidence about whether these extra years of life are spent in good health.

C.2 Stage 2 literature

Table 6: Literature for factors of stage 2

Factor	**Authors**	**Year**	**Main findings**
Employment	Woittiez et al.	(2018)	Employment is hard for the intellectual disability sector. The increase in care demand is caused by multiple factors, like the disappearance of simple jobs and digitalisation for example.
	Dowse	(2009)	Due to globalisation, social life is changing. This has huge consequences for the intellectual disability population. Most companies have the vision to become more efficient, with the result that the simple jobs, perfectly suited for the intellectual disability population, are disappearing.
	Staalduinen and Voorde	(2011)	The disappearance of simple jobs and the increasingly demanding society places on individuals are increasing the number of people who cannot meet these.
	Biezen et al.	(2022)	Simple professions/jobs are disappearing, education has become larger scale and it has become more complicated to arrange practical matters and travelling by public transport.

	Eggink et al.	(2020)	The changes in society increase the chances for traffic accidents, diseases caused by smoking, obesity, alcohol- and drug use, sexually transmitted diseases and loneliness. And the change of being employed will decrease. This will in the end also lead to a higher care demand for the intellectual.
	Ras et al.	(2010)	In the past, people with a low IQ score and a 'simple' job were able to live a relatively normal life. With the disappearing jobs, these people will fall back on the intellectual disability sector for care and support during the day. There is an increased chance of loneliness, which causes a vulnerability for this group with the consequence of a higher chance of addiction problems, sexual behaviour, and criminality due to the more complex society.
	Ministry of Health, Welfare and Sport	(2017)	In the past, people with a low IQ score and a 'simple' job were able to live a relatively normal life. With the disappearing jobs, these people will fall back on the intellectual disability sector for care and support during the day.
Social network	Eggink et al.	(2020)	The social network of someone with an intellectual disability is smaller than someone without a disability. The intensity of the social network is important, because the higher the intensity, the more willing the social network is to support someone with an intellectual disability.
	Ras et al.	(2010)	Due to changes in norms and values in social life, people are more individualistic and less willing to help others. As a consequence, there will be more pressure on the healthcare system.
Technological innovations	Staalduinen and Voorde	(2011)	The need for privacy, the need to own and/or bigger living space, smaller scale, care nearby and customized care, and more control are all facets of the desires in today's society. This is all hard for the intellectual disability population. The use of the internet is increasingly rising in healthcare. But there is also an increase in prostitution, an increase in the use of narcotics, and an increase in aggression and weapons are being found.
	Biezen et al.	(2022)	The ID sector struggles with the 'normal norm'. If participation and inclusion go very difficult, then people with a disability become less and less visible in everyday social life, education and work.

C.3 Stage 3 literature

Table 7: Literature for factors of Stage 3

Factor	Authors	Year	Main findings
Multi-morbidity	Lin et al.	(2016)	The life expectancy of people with an intellectual disability is increasing. Before the age of 40 are most disabled people already experiencing physical decline. However, the consequences of ageing are not the same as in the rest of the population and have bigger impact on the quality of life. More research is needed to discover how the quality of this part of the ageing population can stay high.
	Liao et al.	(2021)	The intellectual disability population has a higher prevalence of other physical conditions compared to the rest of the population. The health profile of an disabled person is much more complex. More global initiatives and research should improve the health of this population.
	Leeuw et al.	(2022)	Most additional physical condition arise at an earlier age for the intellectual disability population.
	Hoekstra et al.	(2018)	Most additional physical condition arise at an earlier age for the intellectual disability population. The vulnerability of the intellectual disability population with the age of 50 can be compared to the vulnerability of the rest of the population with the age of 75.
	Robertson et al.	(2015)	Epilepsy is a common condition among the intellectual disability population. The consequences of a epilepsy seizure are more dangerous compared to the general population. Treatment is also much harder for this population and therefore more training and knowledge is needed to treat and support these people.
	Marriott and Robertson	(2014)	There are adjustments that can be made in the care for epilepsy in the intellectual disability sector. However, these are not yet implemented.
	Strydom et al.	(2010)	Dementia is already appears at the age of 50 for the intellectual disability population. There is recommended to conduct large research to dementia and a disability compared to the general population. At this point, there are too many differences between the finding of the studies.
	Evenhuis	(2011)	For the intellectual disability population and especially the people with the Down Syndrome, the prevalence of dementia is much higher than the general population. Dementia also appears at a young age.

	McGuire et al.	(2006)	People with Down Syndrom have already a great risk of developing dementia from their early 40s. There are still a lot of difficulties regarding the treatment and guidance of this population.
	Strydom et al.	(2009)	Dementia is 2-3 times more common in the intellectual disability sector. In this research there was not difference in the prevalence between the severity of the disability.
	Dillane and Doody	(2019)	The care and guidance needed for someone with an intellectual disability and dementia is different and more complex. Nurses should follow additional courses to make sure the right treatment will be provided.
	Krause et al.	(2016)	The intellectual disability population has a higher chance for obesity, and this is even higher when someone has Down Syndrome. New health policy is needed to minimize the prevalence of obesity.
	De Winter et al.	(2012)	The intellectual disability population has a higher prevalence for obesity. Obesity can cause cardiovascular conditions. Policy is needed to avoid these risks.
	Hsieh et al.	(2013)	The intellectual disability population has a higher prevalence for obesity. A individualistic approach is needed to support this population.
	Staalduinen and Voorde	(2011)	The intellectual disability population has a higher prevalence for obesity. Obesity can cause cardiovascular conditions, cancer, osteoarthritis and complications in pregnancy and surgery. TNO suggest a better collaboration between the health sectors to provide the optimal care for everyone.
	Cuypers et al.	(2022)	The mortality rate due to cancer is 1.5 times higher for the intellectual disability population. At the same time is the prevalence for most cancer forms lower than the general population.
	Boonman et al.	(2022)	The main reason for the high mortality rate due to cancer is the lack of knowledge about detection and treatment.
	Evenhuis	(2014)	These are the factors that should be focused on for the health of the intellectual disability sector: physical activity and fitness, nutrition, cardiovascular risk factors, life events, depression and anxiety, sleeping problems and circadian rest-activity rhythm, multi-morbidity and poly pharmacy.
	Authority	(2020)	The increasing intellectual disability population and the multi-morbidity that arise with the ageing of the population will cause a lot of extra costs for the sector.

Migration	Staalduinen and Voorde	(2011)	People with a migration culture have the culture to care for their own. This means that when a family member had an intellectual disability, he or she will not count on the healthcare system for care and support. Since a couple of years this changed, and because of that the number of people entering the Wlz has been catching up.
	Gommans and Offringa	(2022)	People with a migration culture have the culture to care for their own. This means that when a family member had an intellectual disability, he or she will not count on the healthcare system for care and support. Since a couple of years this changed, and because of that the number of people entering the Wlz has been catching up.
	Ministry of Health, Welfare and Sport	(2017)	People with a migration culture have the culture to care for their own. This means that when a family member had an intellectual disability, he or she will not count on the healthcare system for care and support. Since a couple of years this changed, and because of that the number of people entering the Wlz has been catching up.
Political factors	Jackson	(2017)	In the past, good research led to a change in legislation to improve the quality of life for the intellectual disability. With this is indicated that with good research meaningful changes can be made to the healthcare system to support the intellectual disability population.
	Bigby	(2009)	With the ageing intellectual disability population, there should be thought about the best treatment and guidance for this group. This should also include collaboration with the elderly care and learn from them.
	National Health Care Institute	(n.d.-b)	The Netherlands has had a big system change for the Wlz in 2015. This change was needed to keep up with the changing of needs, for example, people wanting to live at home longer. This change had quite some impact on the intellectual disability sector.

D Trends in the intellectual disability sector

In this appendix, the graphs that are not in the main text and possibly also some extended information will be discussed about the different care profiles.

D.1 VG3

In figure 35 the different age cohorts of the VG3 population are shown. It can be seen that this care profile primarily consists of people between 18 and 49 years old, and almost no minors. Looking more closely at the 18-49 age cohort, there can be seen that the group until 23 years is halved by 2022, while the rest of the group is increasing. The reason for this is, probably, caused by the system change. In the rest of the age cohort between 23 and 49, an increase is visible. It is not possible to visualize these different age cohorts, because two different data sets have been used for this graph which both used different age cohorts.

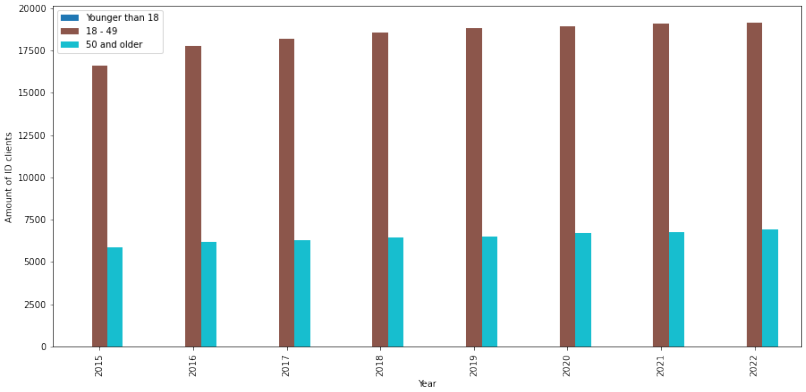


Figure 35: Total VG3 population, based on different age cohorts

In figure 36 is the background of the people who get a VG3 indication visualised. There can be seen that for people with a migration background, the inflow more or less stabilizes after 2016. This can indicate that the 'catching up' of this group is done and there now is a constant inflow. For natives who flow into VG3, there is a continuous decrease visible.

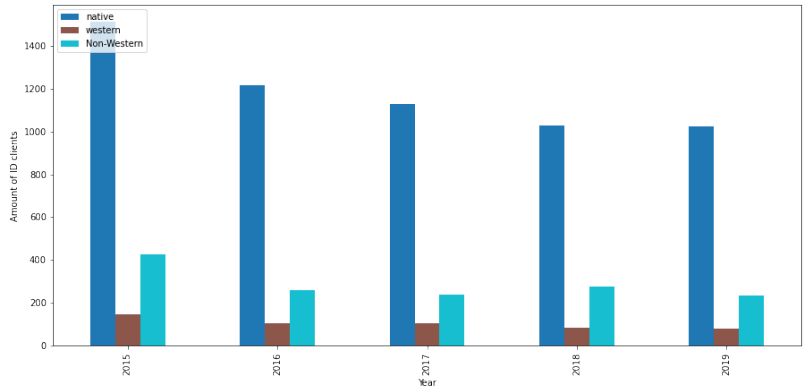


Figure 36: Background of inflow VG3

CBS monitored 4 different direction someone with a VG3 indication can come from, indicating that someone has got another indication before. For VG3, most people who flow in from another sector, come from GGZ or Wlz without a stay or with a short stay. Wlz without stay is a normal switch, there can be experience that it will be better for someone to switch

indication for their own well-being and live in an institution. The switch from GGZ is not expected, since a VG3 indication does not cover behavioural problems. It is possible someone was indicated based on false characteristics.

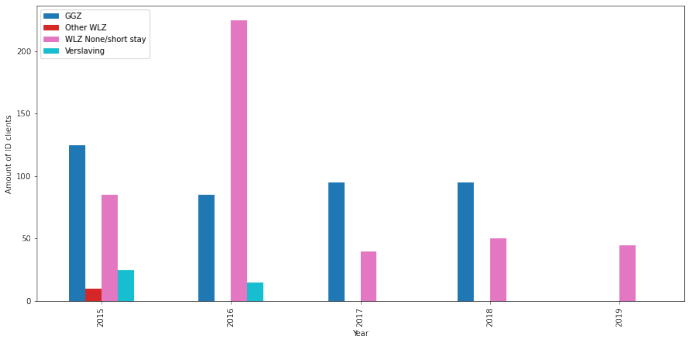


Figure 37: Inflow VG3 from another care sector

Figure 38 shows the reason for outflow of VG3. As was explained in section 5.2, the main reason for outflow is death, which explained the biggest age cohort for outflow. The other reason for outflow is that people will be re-indicated to another Wlz sector.

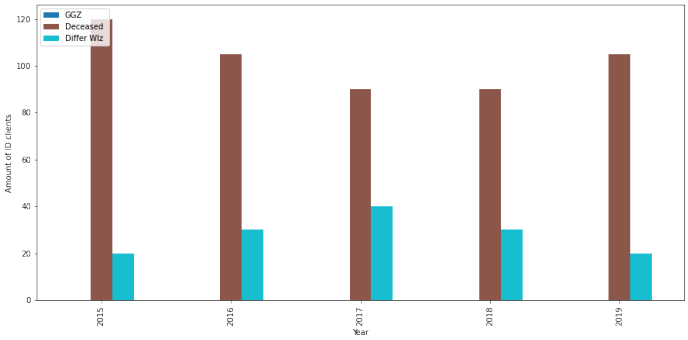


Figure 38: Reason for outflow VG3

D.2 VG4

The VG4 population can participate in social life with guidance and need care and support during daily activities. An important part of the guidance for this group is focused on creating a safe environment for the client. This safe environment will give them structure, which will lead to self-reliance. In Figure 39 can be seen that the increase in this care profile is even steeper than with VG3. In VG4 there is an increase of 38%. This has enormous consequences, in terms of providing care and availability of housing.

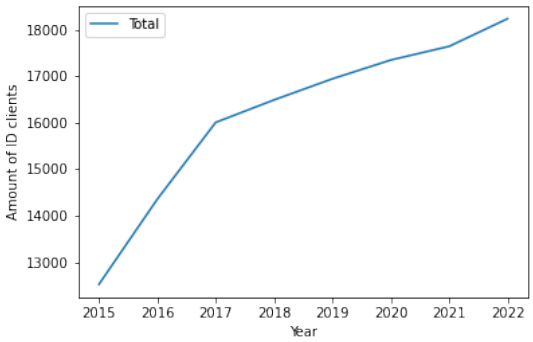


Figure 39: Total increase in VG4

Figure 44 shows the different age cohorts within VG4. The biggest
age cohort is between 18 and 49 years old and this age cohort is also increasing. When looking more closely into the 18-49 age cohort, there can be seen that this group is this big because most people in this care profile are between 18 and 29 years old. This also fits with the big inflow of this age cohort. The other two age cohorts are more or less stable over the years.

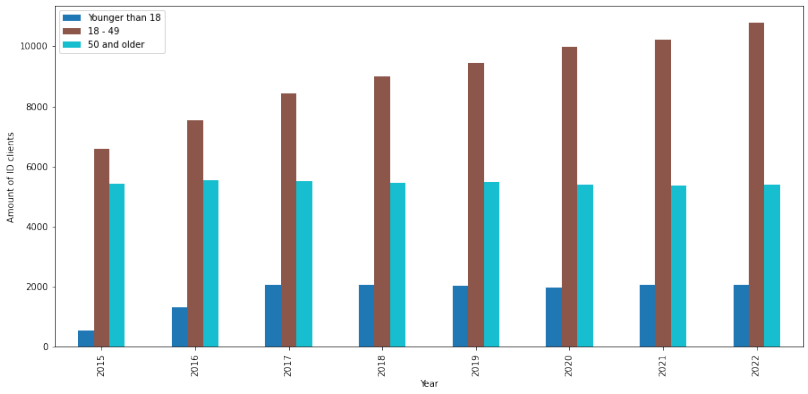


Figure 40: Total VG4 population, based on different age cohorts

Inflow and outflow Figure 41 shows the inflow and outflow of VG4 over the years. Just like with VG3, there is a decrease in inflow and a relatively stable outflow. However, the decrease in the inflow of VG4 is steeper and the difference between the inflow and outflow is not as big. The inflow does stabilise again after 2017, also because of the system change.

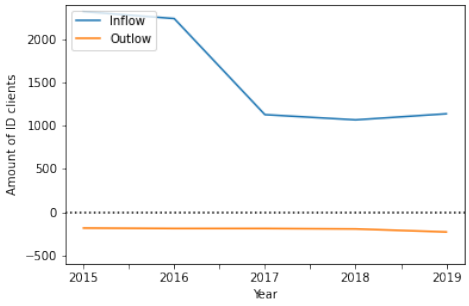


Figure 41: Total inflow and outflow of VG4

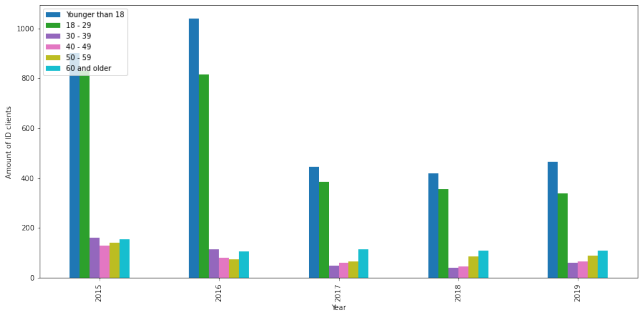


Figure 42: Total inflow VG4, based on age cohorts

Considering the different age cohorts who flow into VG4, something interesting is happening. In Figure 42 can be seen that there are more or less the same amount of people who flow in as minors or as adults (18-49 years old). The difference between VG3 and VG4 is the intensity of the care demand. Someone with a VG4 indication will need the Intellectual Disability sector to provide them care, whereas in the VG3 population relatives or the Youth care act can mostly provide this care. For this reason, a VG4 indication or higher will always have a big inflow of minors. Considering the whole VG4 population, the 28-49 age cohort is still much bigger. Here is again visisble that most people flow in at a young age.

When comparing the age of outflow and the reason for outflow, there can be seen that the main reason is that the client has died. This is also a logical explanation for the age of the group which flows out, which is 50+. These graphs can be found in Appendix D.2.

The average age of mortality of VG4 is more or less stable, shown in Figure 43. Only a small increase is visible from 2015 to 2019. However, this does not mean that ageing does not exist in this profile because the average mortality age does not tell everything about the average age in the VG4 population. When looking at the age cohorts in the VG4 profile, there can be seen that the 50+ group is stable in Figure 44. Another indication that ageing is indeed present in VG4 is the

increasing 18-49 age cohort. This cohort will eventually turn into a 50+ age cohort, and there is a big chance this cohort will also increase with that.

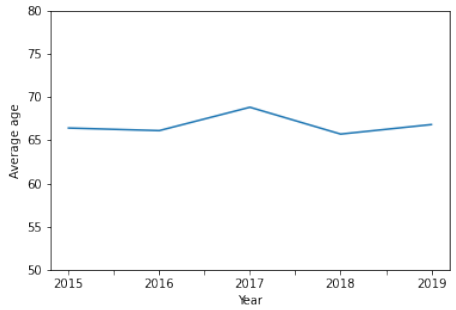


Figure 43: Average mortality age of VG4 population

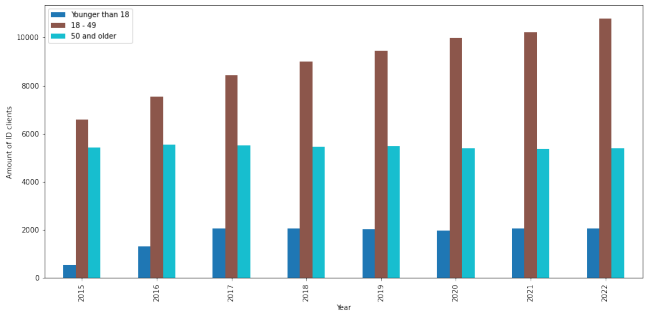


Figure 44: VG4 population, based on age cohorts

There are not a lot of people who flow in from another healthcare sector, with only a big defection in 2016, as seen in figure 45. This is also expected since someone with an intellectual disability indication will be evaluated based on the criteria that the care and support are needed for the rest of their life. Therefore these people (almost) always flow to a higher care profile, because there is extra care needed. Since VG4 is a relatively low care profile, more people are re-indicated to another care profile than the other way around, seen in figure 46. Just like in the VG3 care profile, the main reason for outflow in VG4 is

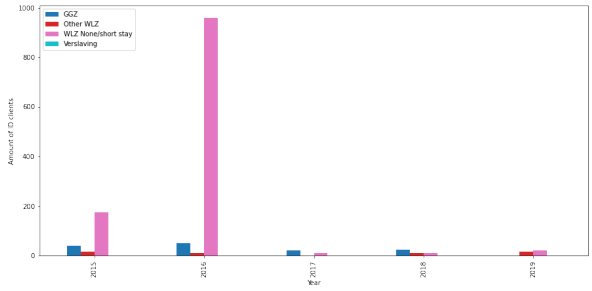


Figure 45: Inflow VG4 from another care sector

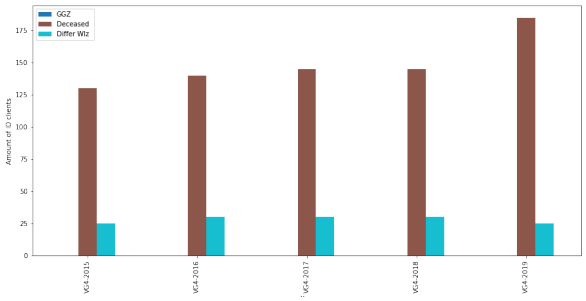


Figure 46: Reason for outflow VG4

As was seen in the previous figure, the main reason for outflow is death. Since the biggest group who flow out of VG4 is the 50 years and older age cohort, this is an expected outcome.

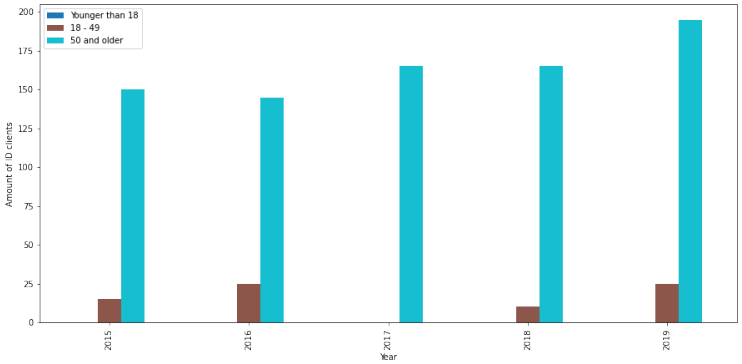


Figure 47: Age of outflow VG4

transfer to another Intellectual Disability care profile Someone with a VG4 indication mostly transfers to VG5 or VG6, when a re-indication has been done. In Figure 48 can be seen that the transfers to both VG5 and VG6 increased over time. However, since the total VG4 population also increased, this is a logical consequence. An interesting observation from these transfers is that the older people get, the more people will transfer to VG5 or VG6. This can be explained by the additional physical conditions of older people. These conditions will ask for adjusted care and support, and in some cases, another care profile will be needed to provide these care needs.

There is a very small part of the VG4 population which gets a re-indication for VG7 or VG8. For the VG7 care profiles, mostly young people transfer while for the VG8 care profile, mostly old people transfer. A possible reason for this can be the behavioural problems that occur in care profile VG7. These behavioural problems already exist at young ages for the intellectual disability population and are not something that will appear later in life.

		Total transfers	Younger than 18	18 - 29	30 - 49	50 and older
Transfer from VG4 to	Year					
VG5	2015 - 2016	445	<10	35	80	320
	2016 - 2017	465	15	60	90	305
	2017 - 2018	470	30	35	65	340
	2018 - 2019	560	20	55	85	400
	2019 - 2020	530	15	40	80	390
VG6	2015 - 2016	220	15	60	65	75
	2016 - 2017	265	15	65	85	95
	2017 - 2018	295	40	80	70	105
	2018 - 2019	305	35	85	95	85
	2019 - 2020	325	35	105	85	95
VG7	2015 - 2016	25	<10	10	<10	<10
	2016 - 2017	45	<10	15	10	<10
	2017 - 2018	40	<10	15	<10	<10
	2018 - 2019	50	15	10	<10	<10
	2019 - 2020	45	10	20	<10	<10
VG8	2015 - 2016	50	<10	<10	<10	30
	2016 - 2017	55	<10	<10	<10	40
	2017 - 2018	50	<10	<10	<10	20
	2018 - 2019	50	<10	<10	<10	25
	2019 - 2020	45	<10	<10	<10	10

Figure 48: Transfer from VG4 to another care profile

D.3 VG5

The VG5 population need constant guidance with a structured daily schedule and fixed and strict living rules and agreements. Some small behavioural problems appear within this group and to some small extent nursing is needed for various conditions. The VG5 population increased by almost 50% over the period 2015 - 2020. In Figure 49 can be seen that the steepness of the increase decreased a little since 2017, but this increased again in 2021. An interesting finding of VG5 is that, of the total VG5 population, most people are 50 years and older. see Figure 50. A reason for this can be the additional nursing that can be provided within this care profile. It is a well-known fact that older people will be coping with additional diseases and therefore will need extra care and support. Another thing that is visible in this figure is the increase of the minor in VG5 in 2016 and 2017. The steep increase in the growth of VG5 in the first years could be explained by that.

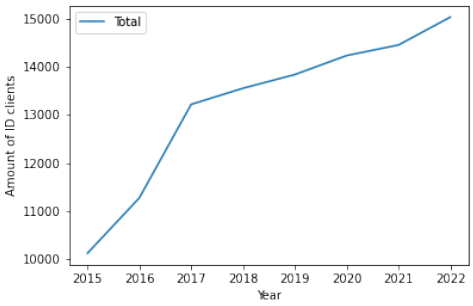


Figure 49: Total increase in VG5

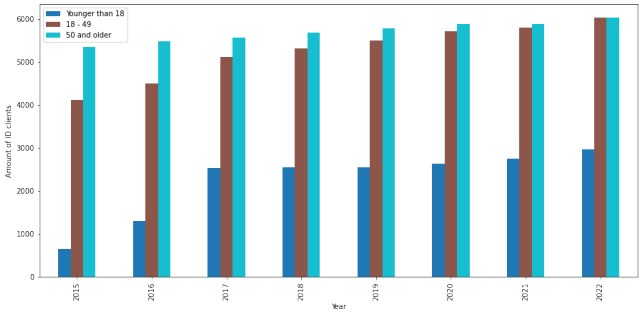


Figure 50: VG5 population, based on age cohorts

Inflow out outflow Figure 51 shows the inflow and outflow of VG5. Just like the other care profiles, the VG5 population has an increased inflow until 2017, because of the system change. However, compared to the previous care profiles, the outflow of VG5 is relatively high and stable. This is an interesting thing since the share of VG5 in the total Intellectual Disability care profiles is very low. The main reason for VG5 clients to flow out is, just like in the other care profiles, that they have died. The inflow is, again, mostly caused by young people, as seen in Figure 52. However, after 2017, the inflow of people between 18 and 29 years old is very low.

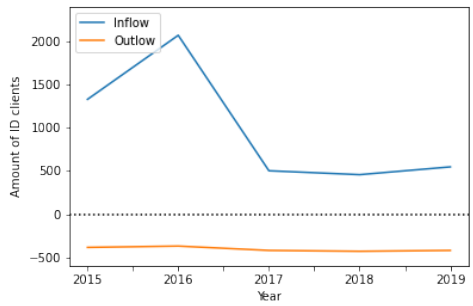


Figure 51: Total inflow and outflow of VG5

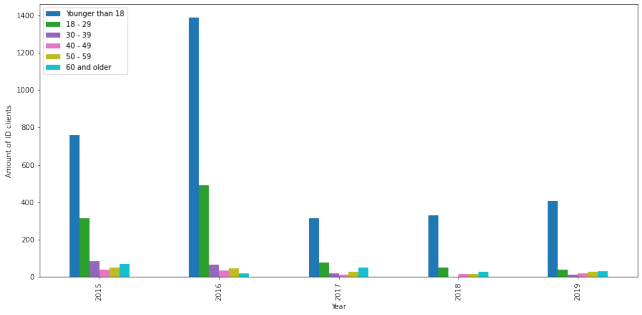


Figure 52: Inflow VG5 based on age cohorts

The average mortality age, seen in Figure 53 of VG5 is more or less stable around 67 years old. Despite the fact that the outflow of people from VG5 is relatively high, the average age of mortality is still comparable with VG4, but relatively high compared to the other care profiles.

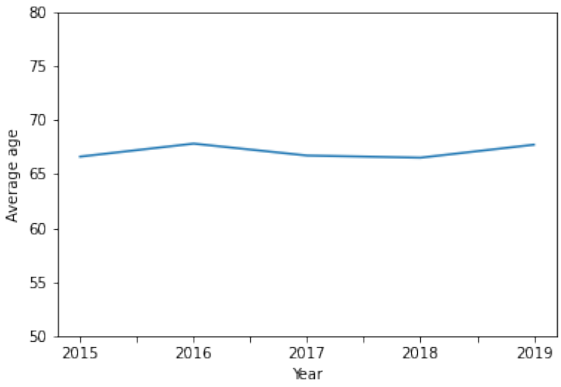


Figure 53: Average mortality age of VG5 population

Figure 54 is more or less the same as the inflow from another sector from VG4, shown in figure 45. The difference is the height of the defection, for VG5 this defection is even higher. For the outflow, the same counts as with the other care profiles, the main reason for outflow is death, as seen in figure 55.

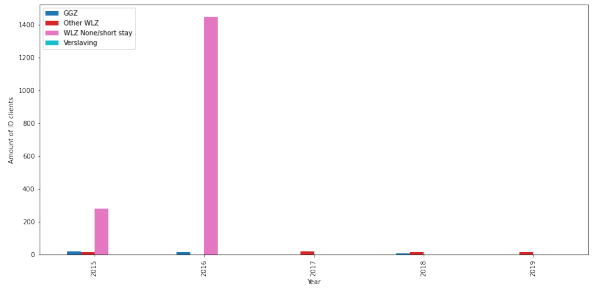


Figure 54: Inflow VG5 from another care sector

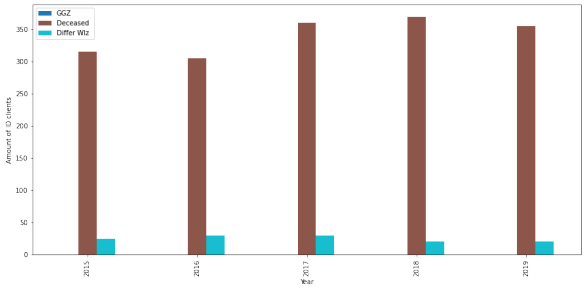


Figure 55: Reason for outflow VG5

In figure 56 can be seen that most people who flow out of VG5 are 50 years or older. This was expected, since the main reason for outflow is death. A small increase in the number of people who flow out is visible, but since the total VG5 population is increase, this is was also expected.

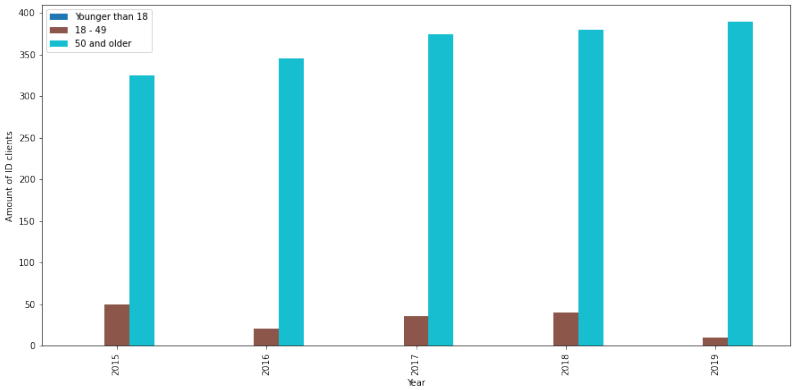


Figure 56: Age of outflow VG5

transfer to another Intellectual Disability care profile Figure 57 shows the care profiles someone with a VG5 indication transferred to over the years. Interestingly enough, there were no transfers to VG6, while before there was found that most care profiles transferred to the next care profile. Most people transfer to VG8, cause this is also a care profile which does not include behavioural problems. Someone with a VG5 indication will only have small behavioural problems in some cases. The same counts for VG8, and therefore the biggest group of transfers from VG5 will get a VG8 re-indication. There are some people who were re-indicated with VG7. The reason for this is the extra nursing that will be provided within this care profile. This extra nursing will not be provided within the VG6 indication.

The people who transfer to VG8 are mostly 50 years and older. This is caused by the additional nursing older people need and which can be provided in VG8. There is only a very small increase in transfers over the years, and this is not in proportion with the growth of the VG5 population.

Transfer from VG5 to	Year	Total transfers	Younger than 18	18 - 29	30 - 49	50 and older
VG7	2015 - 2016	110	15	20	20	40
	2016 - 2017	130	15	30	30	40
	2017 - 2018	205	50	35	35	80
	2018 - 2019	185	45	35	40	65
	2019 - 2020	160	40	40	<10	65
VG8	2015 - 2016	320	10	10	35	255
	2016 - 2017	315	<10	15	40	250
	2017 - 2018	280	15	15	40	210
	2018 - 2019	355	30	15	35	275
	2019 - 2020	340	25	20	90	260

Figure 57: Transfer from VG5 to another care profile

D.4 VG6

Someone with a VG6 indication needs individual guidance and is also coping with structural and often cumulative behavioural problems. The care and support for this group are very time and effort intensive. The VG6 population increased by almost 25% over a period of 7 years, seen in Figure 58. This is a smaller increase compared to the previous care profiles. Regarding that this care profile is the biggest of the total Intellectual Disability population, this is not a bad thing. Within the VG6 population, the different age cohorts will be more or less the same over the years.

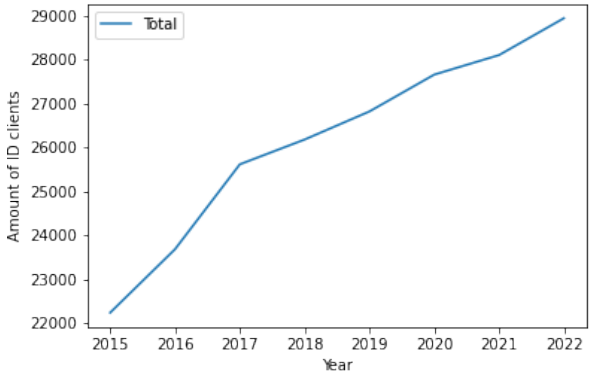


Figure 58: Total increase in VG6

In figure 59 is the VG6 care profiles based on different age cohorts shown. The 18 to 49 age cohorts is the biggest group in this care profile and is slightly increasing over the years. The 50 years and older age cohort is also slightly increasing, while the minor cohort is a bit fluctuating. Since this care profile is also covering behavioural problems, it is desirable to make sure this group is not becoming too big. This slight increasing is fine, since it is growing the growth of the total population.

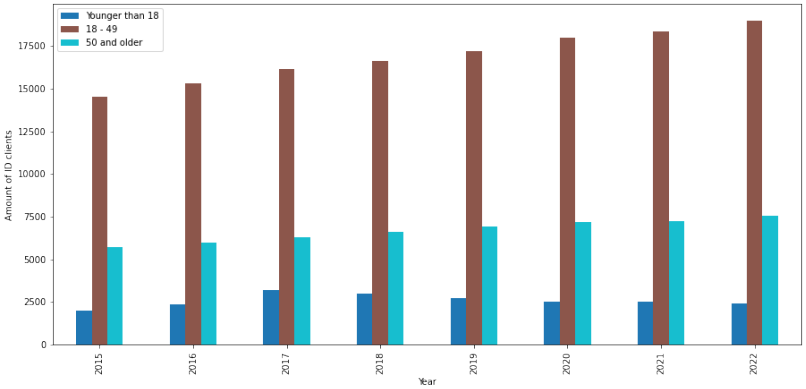


Figure 59: Total VG6 population, based on different age cohorts

Inflow and outflow In Figure 60, can be seen that the inflow and outflow of VG6 follow more or less the same trend as VG5. The difference is that VG6 is much bigger, and therefore has more people flowing in. Regarding the different age cohorts which flow into VG6, there can be seen that also in this care profile, most people who receive a VG6 indication are 29 years or younger. The smaller outflow of VG6 compared to VG5 would also explain the difference in the share of the total population. VG6 is the biggest care profile.

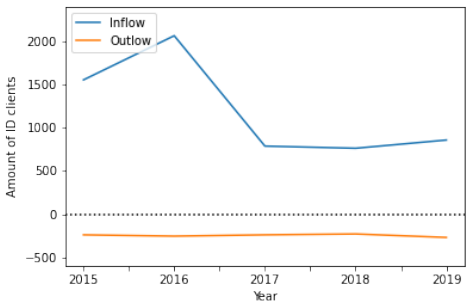


Figure 60: Total inflow and outflow of VG6

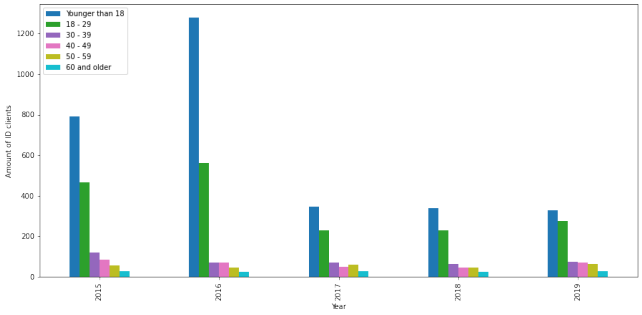


Figure 61: Inflow VG6 based on age cohorts

Just like with VG3, the outflow of the 18 - 49 year cohort is very visible. In Figure 62 can be seen that in 2015 this was almost equal to the 50+ cohort, but later this was getting further apart. However, the reason for outflow stays the same as the other care profiles. The main reason for outflow is that the clients are dying. This indicates that younger people are also dying when they have a VG6 indication. A possible reason for this could be behavioural problems, which in some cases lead to psychiatric problems. Since these psychiatric problems need to be cared for in another way Intellectual Disability clients need to be treated, and this could lead to life-threatening situations for the Intellectual Disability clients. In Chapter 4 was already found that more collaboration should take place between different healthcare sectors. These psychiatric problems prove that this should happen.

The average age of mortality, see Figure 63 in this care profile is lower and fluctuation more than in the previous care profiles. The psychiatric problems that arise in this care profile can explain this phenomenon.

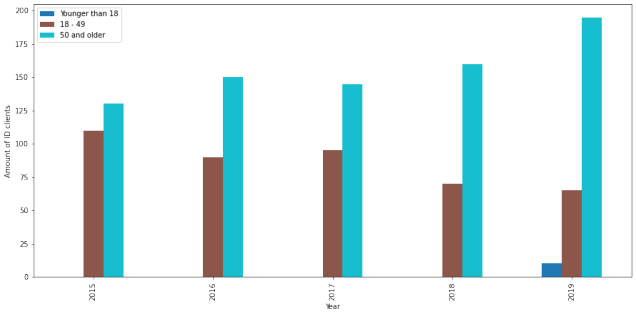


Figure 62: Total outflow VG6, based on age cohorts

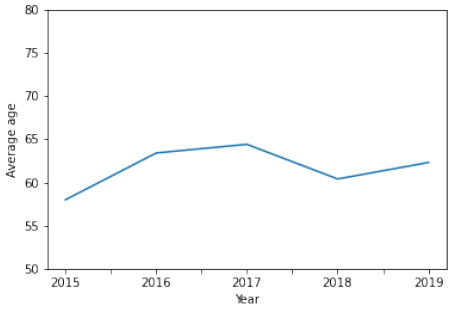


Figure 63: Average mortality age of VG6 population

Just like with the other care profiles, there is a large defection in 2016 for the inflow from another sector, the Wlz with none or short stay. This has to do with the system change in 2015 and everybody that had to be switched before 2017. In figure 64 there can be seen that after that year the inflow is relatively low and stable. However, considering the behavioural problems in this care profile, it should be expected that there will be transfers from and to the GGZ. This is also visible in the outflow reasons from figure 65. Better collaboration between this sector should be happening to improve the care and support for people with an intellectual disability combined with behavioural problems.

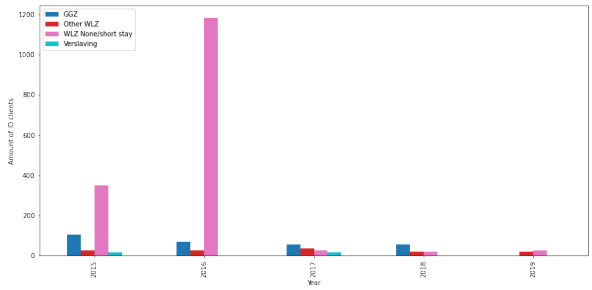


Figure 64: Inflow VG6 from another care sector

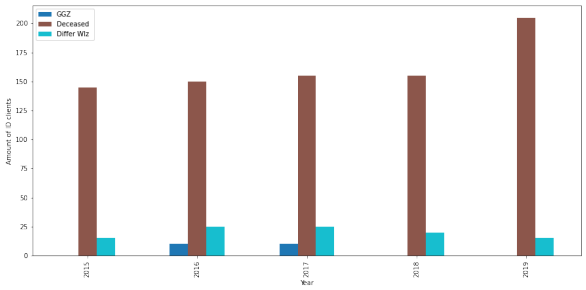


Figure 65: Reason for outflow VG6

transfer to another Intellectual Disability care profile Looking into the transfers from VG6 in Figure 66, it becomes clear that clients with a VG6 indication can get different re-indications. However, most people who transfer get a VG7 indication. This is a logical re-indication because VG7 includes, just like VG6, behavioural problems and these are treated within that indication. An increase is visible in the number of people who transfer from VG6 to VG7. This was also expected with the increase in the total VG6 population.

Receiving a re-indication for a VG5 or VG8 indication will happen mostly when the clients are 50 years or older. The main reason for this will be the change in the care demand of older people. These two profiles included more nursing and will therefore become more fitted for the ageing population. This could also indicate that these people would just need more care from the elderly sector. To make this happen, collaboration is needed.

Transfer from VG6 to	Year	Total transfers	Younger than 18	18 - 29	30 - 49	50 and older
VG3	2015 - 2016	40	< 10	30	< 10	< 10
	2016 - 2017	45	< 10	30	< 10	< 10
	2017 - 2018	45	< 10	30	< 10	< 10
	2018 - 2019	30	< 10	25	< 10	< 10
	2019 - 2020	30	< 10	20	< 10	< 10
VG5	2015 - 2016	55	< 10	<10	<10	35
	2016 - 2017	55	< 10	<10	<10	25
	2017 - 2018	80	< 10	10	15	35
	2018 - 2019	70	< 10	<10	<10	45
	2019 - 2020	80	< 10	<10	10	45
VG7	2015 - 2016	495	100	175	115	105
	2016 - 2017	515	105	150	150	120
	2017 - 2018	595	155	155	155	135
	2018 - 2019	625	145	185	145	150
	2019 - 2020	610	125	205	150	125
VG8	2015 - 2016	45	< 10	< 10	< 10	30
	2016 - 2017	50	< 10	< 10	< 10	20
	2017 - 2018	45	< 10	< 10	< 10	30
	2018 - 2019	55	< 10	< 10	< 10	35
	2019 - 2020	45	< 10	< 10	< 10	35

Figure 66: Transfer from VG6 to another care profile

D.5 VG7

In figure 67 can be seen that the age cohorts are slightly increasing and that the 18 - 49 age cohorts is again the biggest age cohort. Since the VG7 care profiles is the most intensive care profile to care for, it is important that it does not grow too much.

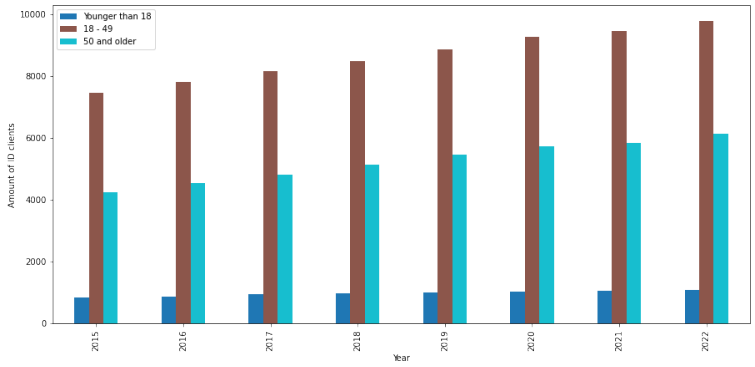


Figure 67: Total VG7 population, based on different age cohorts

Figure 68 shows the average mortality age of the VG7 population. The mortality age is relatively low in this care profile and is not changing a lot. This is also due to the extreme behavioural problems that occur within this care profile. The average age of outflow is again mostly the elderly people, as seen in figure 69. When a better collaboration will be in place with GGZ, there will also be more outflow of younger people.

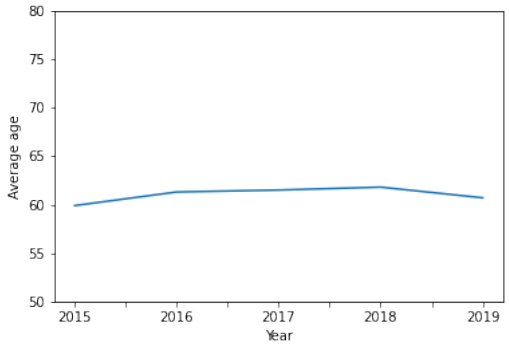


Figure 68: Average mortality age of VG7 population

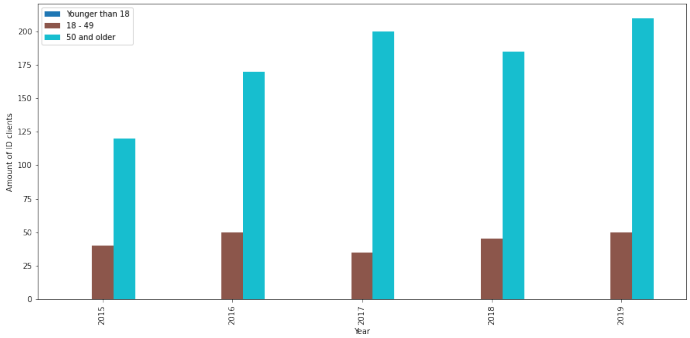


Figure 69: Age of outflow VG7

D.6 VG8

Someone with a VG8 indication is multiplied disabled and therefore needs a lot of care and support. Next to this, nursing care is also required for this part of the Intellectual Disability population. In this care profile, there are barely any behavioural problems. In Figure 70 can be seen that there is a very steep increase until 2017 and after that, the VG8 population is relatively stable. Looking more closely at the different age cohorts within the VG8 population in Figure 71, there can be seen that the group or elderly stays more or less the same over the years. While the other two age cohorts are increasing after 2017.

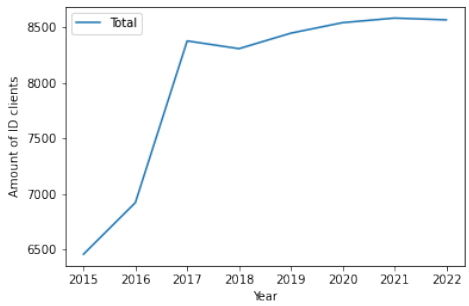


Figure 70: Total growth VG8

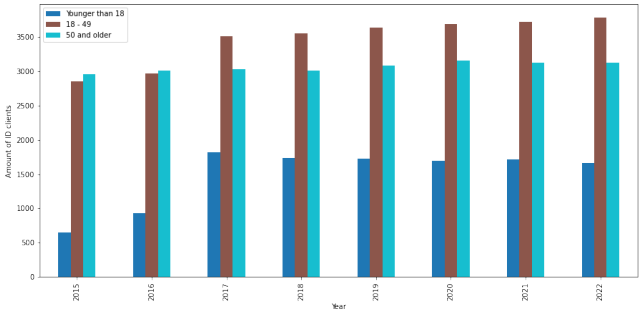


Figure 71: VG8 population, based on age cohorts

Inflow and outflow Figure 72 shows the total inflow and outflow of VG8. This graph shows again an increase before 2017 and a decrease after that for the inflow. This big increase is caused, just like with the other care profiles, by the system change. Interestingly, after 2017 there are almost only minors who get a VG8 indication. A possible explanation for this can be the severity of the disability. Someone who gets a VG8 indication has multiple disabilities and needs a lot of nursing for this. This form of intellectual disability already appears at a young age and is not likely to evolve later in life. Therefore there are mostly minors who get a VG8 indication.

The outflow shows a big increase in 2017, after which it decreases again. Just as with the other care profiles, the biggest age cohort which flows out of VG8 are the people 50 years and older. This also explains that the main reason for outflow is death. The average age of mortality in the VG8 population is relatively low as shown in Figure 74. The reason for this is that multiple disabilities are present in this part of the population, which makes life expectancy lower.

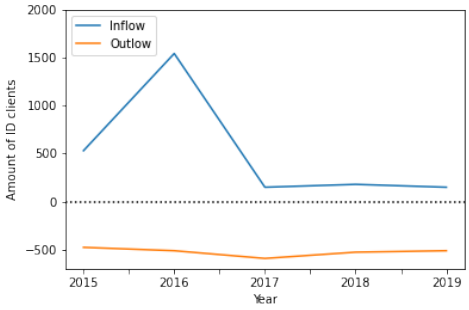


Figure 72: Total inflow and outflow of VG8

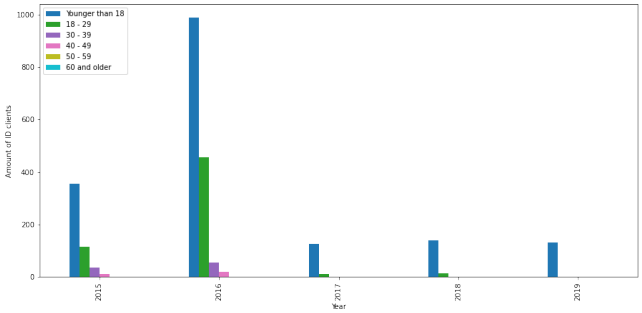


Figure 73: Inflow VG8 based on age cohorts

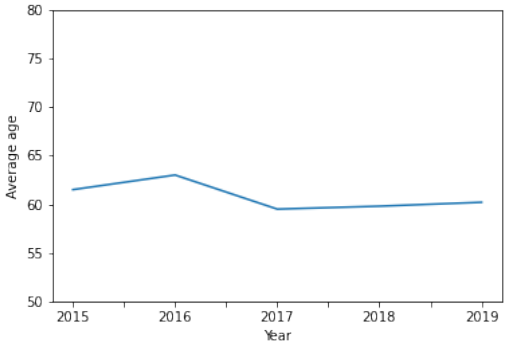


Figure 74: Average mortality age of VG8 population

In Figure 75 and 76 are the reasons for in- and outflow shown. There is, again, a big deflection in 2016 for the Wlz none or short stay and death as the main reason for outflow. In this care profile a lot of extra nursing is needed for the disabled people, which can perhaps also be provided by other sector, which can be improved by collaboration between the sectors.

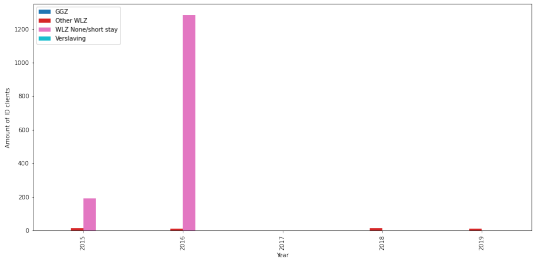


Figure 75: Inflow VG8 from another care sector

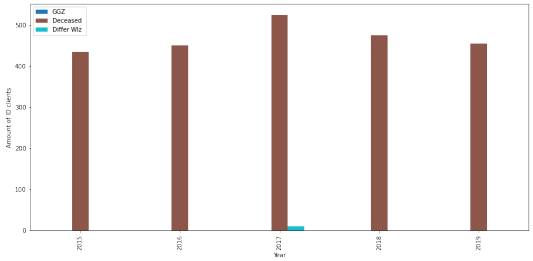


Figure 76: Reason for outflow VG8

Figure 77 shows the age cohorts for the outflow of VG8. There can be seen that the biggest group for outflow are the elderly, which was also expected regarding the main reason for outflow. Also, the other age cohorts have some outflow. This indicates that there are also people dying in the younger age cohorts since there are almost no other reasons for outflow.

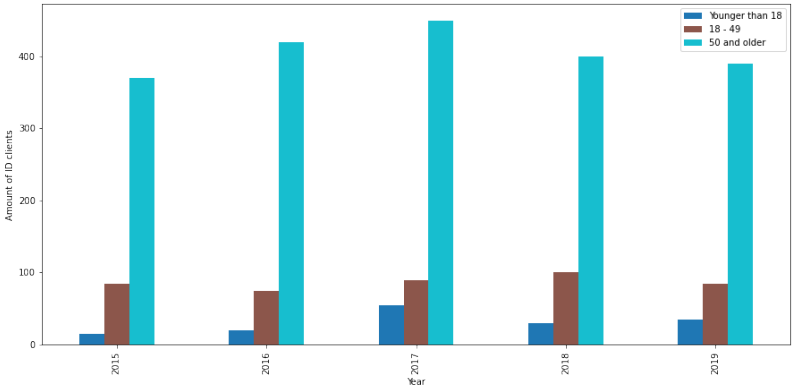


Figure 77: Age of outflow VG8

Transfer to another care profile There are (almost) no people who transfer from a VG8 indication to another Intellectual Disability indication. The main reason for this is that the availability of multiple disabilities and the care and support needed for this group will only be in this care profile. VG8 is the only care profile which can provide fitting care for this kind of disability.

E Model conceptualisation

In this appendix, the relation in the causal loop diagram will be further explained. The causal loop diagram can be found in section 6

Table 8: Overview of relation in the causal loop diagram

From	To	Relation (+, - or ?)	Explanation
Self-reliance	Social network	+	Someone who is more self-reliant will be able to undertake more activities individually. This will give the opportunity to meet new people and make new friends. The higher the self-reliance the more capable someone is to make new friends (Eggink et al., 2020).
Self-reliance	Education level	+	The higher the self-reliance, the more capable someone is to follow an education. Someone who is not very self-reliant has a higher chance of falling behind on education and might need to transfer from a regular school to a special school which provides additional guidance (Eggink et al., 2020).
Self-reliance	Employed intellectual disability population	+	The more self-reliant someone with an intellectual disability is, the more capable he or she is to work (Eggink et al., 2020; Staalduinen & Voorde, 2011; Woittiez et al., 2018; Dowse, 2009).
Self-reliance	Care-dependent people	-	The less self-reliant the population with a low IQ score, the more care-dependent they will be (Eggink et al., 2020; Ras et al., 2010).
Social network	Self-reliance	+	When someone with a low IQ score has a small social network, they will not be able to ask someone within their social network to help them. Some tasks can therefore not be carried out by someone, causing the self-reliance to decrease (Eggink et al., 2020).
Social network	Care at home	?	Someone with a social network has a higher chance of being cared for by someone from that network. When the social network will be bigger, the chance will increase. However, this does not go on, at some point additional friends will not increase the home care. Therefore, the relation is classified as '?' (Eggink et al., 2020).
Care at home	Care-dependent people	-	When more care at home is provided, by someone's social network for example, people will be less care dependent (Eggink et al., 2020; Ministry of Health, Welfare and Sport, 2017).
E-health	Care at home	+	E-health will increase the ability for a social contact to care and support another social contact, since E-health can give instructions on what to do and when (Staalduinen & Voorde, 2011; Biezen et al., 2022).
E-health	Care-dependent people	?	Technological innovations, such as E-health, both have positive as well as negative effects on the care-dependency of people with a low IQ score. On the one hand this will help being able to live at home and cared for by a social contact. On the other hand can the E-health make someone feel isolated, since social interactions is an important element of life for someone with a low IQ. Therefore this relation is classified with '?' (Staalduinen & Voorde, 2011; Biezen et al., 2022)

Education level	Social network	+	The higher the education level, the larger social network. The reason for this is that people with a higher education level attended mostly regular schools, and therefor also a lot of social activities, which makes them able to create a bigger social network (Eggink et al., 2020).
Employed intellectual disability population	Self-reliance	+	Being able to work will provide people with a low IQ score a lot of structure in their daily life, which will help them to take care to themselves more easily, allowing them to increase their self-reliance (Eggink et al., 2020; Woittiez et al., 2018; Staalduinen & Voorde, 2011; Dowse, 2009).
'simple' jobs	Employed intellectual disability population	+	The intellectual disability population is most suited to be employed for 'simple' jobs. When these jobs are disappearing, caused by automation, there will be less people employed. Most of the employers are also not comfortable with hiring people with an intellectual disability (Biezen et al., 2022; Staalduinen & Voorde, 2011; Dowse, 2009).
Automation of jobs	'simple' jobs	-	Due to the automation of jobs, a lot of 'simple' jobs are disappearing (Biezen et al., 2022; Staalduinen & Voorde, 2011; Dowse, 2009; Eggink et al., 2020).
Employed intellectual disability	Addiction	-	If the population with an intellectual disability gets unemployed, while they were employed before, there is a higher chance for them to get into problems regarding addiction because the structure in their daily life disappeared. This chance is higher since this group of people is more vulnerable (Ministry of Health, Welfare and Sport, 2017).
Addiction	Care-dependent people	+	Eventually, people with an addiction can get an intellectual disability and will be care-dependent to get through the day (Ministry of Health, Welfare and Sport, 2017).
Severity of intellectual disability	Social network	-	The more severe the intellectual disability, the more limitations in the adaptive functioning of someone with an intellectual disability. Therefore, the chance of creating a big social network will be small (Prinsen Stichting, n.d.; Ministry of Health, Welfare and Sport, 2022).
Severity of intellectual disability	Education level	-	The more severe the intellectual disability, the more limitations in the adaptive functioning of someone with an intellectual disability. Therefore, someone needs to go to a special school which provides extra guidance. Unfortunately, this also means the education level will be lower (Prinsen Stichting, n.d.; Ministry of Health, Welfare and Sport, 2022).
Severity of intellectual disability	Employed intellectual disability population	-	The more severe the intellectual disability, the more limitations in the adaptive functioning of someone with an intellectual disability. Therefore, the ability to perform a job is smaller (Prinsen Stichting, n.d.; Ministry of Health, Welfare and Sport, 2022).
Severity of intellectual disability	Self-reliance	-	The more severe the intellectual disability, the more limitations in the adaptive functioning of someone with an intellectual disability. This means the self-reliance is lower (Prinsen Stichting, n.d.; Ministry of Health, Welfare and Sport, 2022).
Innovation on medical field	ageing	+	Due to innovation on medical field, there will be better and more specialised treatments and medical screening for diseases. This will increase the life expectancy and with that the population is ageing (Evenhuis, 2011; Biezen et al., 2022; Lin et al., 2016).

Ageing	Number of indications	+	When the intellectual disability population is ageing, the outflow of people with an indication will be lower, and therefore the total number of indications will be bigger (Lin et al., 2016; Staalduinen & Voorde, 2011; Gommans & Offringa, 2022).
Ageing	Care-dependent people	+	When the care-dependent population is ageing, the outflow of people with an indication will be lower, and therefore the total number of indications will be bigger (Lin et al., 2016; Staalduinen & Voorde, 2011; Gommans & Offringa, 2022).
Care-dependent people	Request for care from Wlz	+	When the care-dependent population with a low IQ increases, more people will be dependent on the healthcare sector for care. More requests will be applied for care from Wlz.
Innovation on medical field	Artificial insemination	+	Due to innovation on medical field, there will be better and more specialised treatments and more knowledge about medical how to help woman get pregnant with artificial insemination (Staalduinen & Voorde, 2011; Ras et al., 2010).
Innovation on medical field	Prenatal screening	+	Due to innovation on medical field, there will be better and more specialised treatments and more knowledge about medical how to screen a pregnant woman and what can be learnt from the screening (Staalduinen & Voorde, 2011; Ras et al., 2010).
Artificial insemination	Births with ID	+	The chance of having a baby with an intellectual disability is higher when a woman gets pregnant via artificial insemination (Staalduinen & Voorde, 2011).
Births/ pregnancy defects	Births with ID	+	When there are defects or problems during the pregnancy of birth, like oxygen deficiency, there is a higher chance of having a baby with an intellectual disability (DisabledNL, n.d.-a).
Prenatal screening	Births with ID	?	With better prenatal screening there can be identified whether the baby has a high chance of having an intellectual disability. There are women who choose to end the pregnancy with that knowledge. However, this does not mean these women will do that, therefore the relation is a '?' (Staalduinen & Voorde, 2011)
Prenatal screening	Syndrome	?	With better prenatal screening there can be identified whether the baby has a high chance of having a syndrome. There are women who choose to end the pregnancy with that knowledge. However, this does not mean these women will do that, therefore the relation is a '?' (Staalduinen & Voorde, 2011)
Syndrome	Births with ID	+	A syndrome can cause an intellectual disability. Therefore, when more people are born with an syndrome, more babies will also be born with an intellectual disability (DisabledNL, n.d.-b).
Disease	ID on later age	+	Not everyone has an intellectual disability since birth. Some people get it at a later age, caused by a major accident or disease. Cite cause_vg
Major accident	Syndrome	+	Not everyone has an intellectual disability since birth. Some people get it at a later age, caused by a major accident or disease. Cite cause_vg
Non-western population	Cousin marriages	+	For the non-western population, cousin marriages are more usual. In 2010, 25% of the Dutch Turkish and Moroccan people were in a cousin marriage (Ras et al., 2010).

Cousin marriages	Births with intellectual disability	+	Cousin marriages have a higher chance of having a child with an intellectual disability. When the number of cousin marriages, this cause of an intellectual disability will decrease (Ras et al., 2010).
Non-western population	Request for care from Wlz	+	There was found that more people with an non-western background applied for care from Wlz (Gommans & Offringa, 2022; Staalduinen & Voorde, 2011).
Births with ID	Request for care from Wlz	+	When more people have an intellectual disability, more requests will be done to receive care from Wlz
Get an intellectual disability later in life	Request for care from Wlz	+	When more people have an intellectual disability, more requests will be done to receive care from Wlz
Request for care from Wlz	Number of indications	+	If more requests will be done with Wlz, more indications will be granted.
Request for care from Wlz	Pressure on the intellectual disability sector	+	When the number of requests increases, a pressure on the intellectual disability sector will arise, since all these people need to be cared for and a place for them to live need to be found.
Pressure on the intellectual disability sector	Investment government	+	If the pressure on the intellectual disability sector becomes too large, the government can decide to invest in the sector to help calm down the pressure.
Investment government	Knowledge ageing intellectual disability population	+	A possible investment can be to research the consequences of ageing for the intellectual disability sector. This should increase the quality of care for this population (Staalduinen & Voorde, 2011).
Knowledge ageing intellectual disability population	Care-dependent people	-	When there is more knowledge on the ageing intellectual disability population, the quality of the care will increase and therefore people can also be relocated within other healthcare facilities for better care. This means that the number of care-dependent people will decrease, since the most fitted care will be found earlier.
Investment government	Capacity in intellectual disability institutions		Another possibility for investment by the government is to expand the capacity, by building new intellectual disability institutions fore example.
Capacity in intellectual disability institutions	Pressure on the intellectual disability sector	_	When the capacity is expanded, the pressure on the intellectual disability sector will decrease, because more people can get a place to live and be cared for.
Capacity in intellectual disability institutions	Shortage of places in intellectual disability institutions	-	The shortage of institutional places for the intellectual disability sector will decrease once the capacity is expanded.

Number of indications	Shortage of places in intellectual disability institutions	+	With more indications, and the same capacity, the shortage will increase more.

F Model formulation

In this chapter, the model formalisation of the intellectual disability model is elaborated on. The chapter will be split up into three sections, each representing one of the sub-model. First the population sub-model, after that the self-reliance sub-model, and last the indications sub-model. The section will elaborate on the equations of the variables and the input values used in the model. For the input values derived from a data set, they will be referred. For the assumptions, there will be stated 'own interpretation'. For more information on the assumptions, see chapter 6.2.4

F.1 Population sub-model

The first sub-model is the population sub-model. This sub-model calculates the number of the total number of people in the Netherlands, and than divides them into three different IQ groups. The allocation of the different IQ groups will be based on the IQ normal distribution in the Netherlands (Ras et al., 2010).

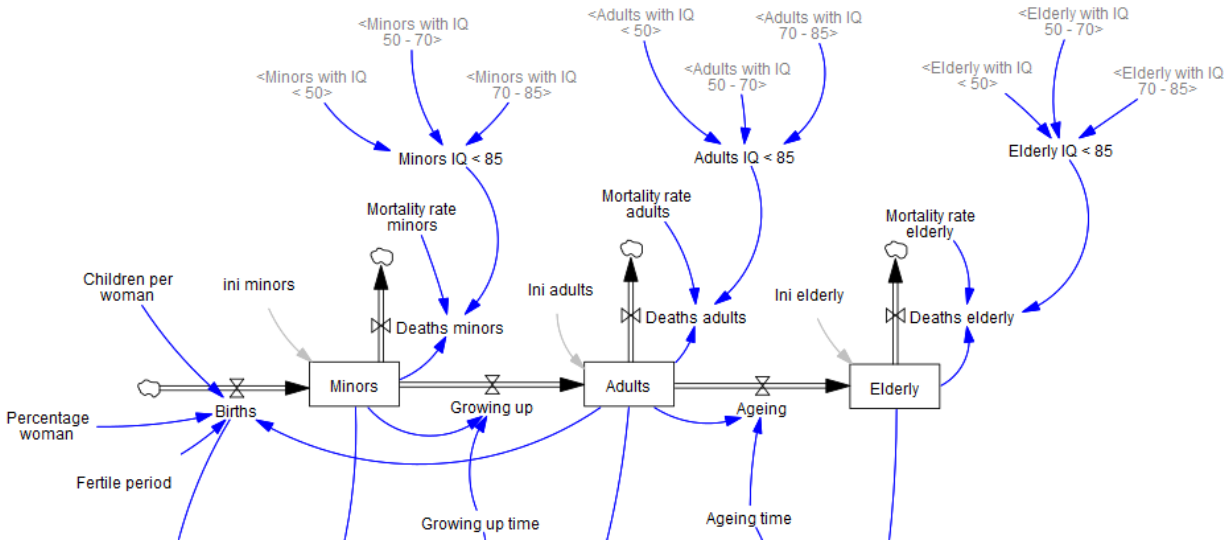


Figure 78: Overview of the model of the total population

Table 9: Overview of variables in the total population sub-model

Variable	Unit	Value	Equation	Explanation
Births	Person/Year	-	((Adults*Percentage woman)*Children per woman)/Fertile period	Only the woman in the population are able to have children, so first the number of woman in the population need to calculated. After that, this will be multiplied with the average number of children a woman has over the fruitful years.
Percentage woman	Dmnl	0.5	-	(CBS, 2015)
Children per woman	Dmnl	1.7	-	(CBS, 2020)
Fertile period	Year	24	-	Women are officially fertile between 15 and 50 years old. However, for this model there is assumed the average fertile period is 24 years (CBS, 2020, 2017).

Minors	Person	-	INTEG(Births – Deaths – Growing up)	The number of minors in a specific year is the number of minors from the previous year plus the new births minus the minors who died and the minors who grew up.
Ini minors	Person	3.429.190	-	(CBS, 2015)
Growing up	Person/Year	-	Minors / Growing up time	This is the group of minors who are growing up and becoming adults.
Growing up time	Year	17	-	This is the number of years someone is a minor, which means until the age of 17.
Deaths minors	Person/Year	-	(Minors-"Minors IQ <85") * Mortality rate minors	This represents the group of minors who will dy. The group of minors with an IQ below 85 will first be deducted from the total number of minors because people with a low IQ have a higher mortality rate and to be sure that the people who died will not be double counted for.
Mortality rate minors	Dmnl	0.00114667	-	The found mortality rate on CBS is for the total population, this represents the mortality rate of the population with an IQ above 85, so it is smaller (CBS, 2022).
Adults	Person	-	INTEG(Growing up-Ageing-Deaths adults)	The number of adults in a specific year is the number of people from the previous year plus the minors who grew up minus the adults who died and the adults which aged.
Initial adults	Person	6.996.094	-	(CBS, 2015)
Ageing	Person/Year	-	Adults / Ageing time	The group of adults which are ageing, meaning they are above the age of 49.
Ageing time	Year	32	-	This is the number of years someone is a adults, which means until aged between 18 and 49 years old.
Deaths adults	Person/Year	-	(Adults-"Adults IQ <85")*Mortality rate adults	This represents the group of adults who will dy. The group of adults with an IQ below 85 will first be deducted from the total number of adults because people with a low IQ have a higher mortality rate and to be sure that the people who died will not be double counted for.
Mortality rate adults	Dmnl	0.00025875	-	The found mortality rate on CBS is for the total population, this represents the mortality rate of the population with an IQ above 85, so it is smaller (CBS, 2022)
Elderly	Person	-	INTEG(Ageing-Deaths elderly)	The number of elderlies in a specific year is the number of people from the previous year plus the ones who aged minus the elderly who died.
Initial elderly	Person	6.496.224	-	(CBS, 2015)

Deaths elderly	Person/Year	-	(Elderly-"Elderly IQ <85")*Mortality rate elderly	This represents the group of elderly who will dy. The group of elderly with an IQ below 85 will first be deducted from the total number of elderly because people with a low IQ have a higher mortality rate and to be sure that the people who died will not be double counted for.
Mortality rate elderly	Dmnl	0.02926160	-	The found mortality rate on CBS is for the total population, this represents the mortality rate of the population with an IQ above 85, so it is smaller (CBS, 2022)
Minors with IQ <85	Person	-	"Minors with IQ <50"+"Minors with IQ 70 - 85"+"Minors with IQ 50 - 70"	This are all the minors with an IQ score below 85, which will be calculated in the other parts of the population sub-model.
Adults with IQ <85	Person	-	"Adults with IQ <50"+"Adults with IQ 50 - 70"+"Adults with IQ 70 - 85"	This are all the adults with an IQ score below 85, which will be calculated in the other parts of the population sub-model.
Elderly with IQ <85	Person	-	"Elderly with IQ <50"+"Elderly with IQ 50 - 70"+"Elderly with IQ 70 - 85"	This are all the elderly with an IQ score below 85, which will be calculated in the other parts of the population sub-model.

F.1.1 Population with an IQ score below 50

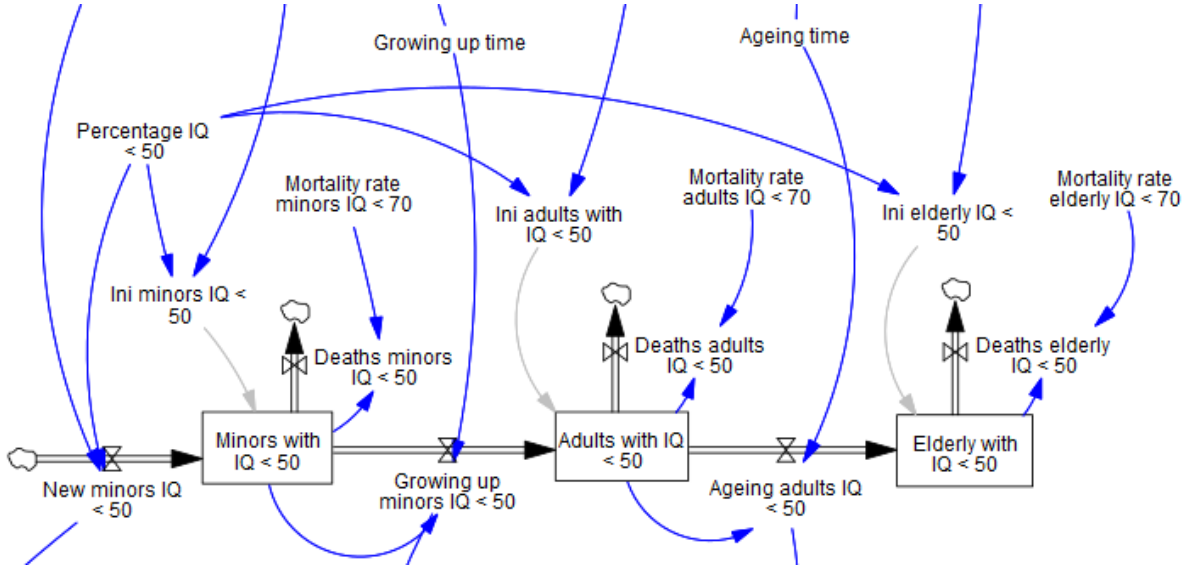


Figure 79: Overview of the model of the population with an IQ score below 50

Table 10: Overview of variables in the population model with an IQ score below 50

Variable	Unit	Value	Equation	Explanation

New minors is <50	Person/Year	-	"Percentage IQ <50"*Births	The new minors are the percentage of the births with an IQ score below 50.
Percentage IQ <50	Dmnl	0.001	-	(Ras et al., 2010)
Minors	Person	-	INTEG("New minors IQ <50"-"Deaths minors IQ <50"-"Growing up minors IQ <50")	The number of minors with an IQ score below 50 in a specific year is the number of people from the previous year plus the new minors minus the minors who died and the minors who grew up.
Ini minors	Person		"Percentage IQ <50"*Minors	The percentage of the total minors who have an IQ score below 50.
Growing up minors IQ <50	Person/Year	-	"Minors with IQ <50"/Growing up time	This is the group of minors who are growing up and becoming adults.
Deaths minors IQ <50	Person/Year	-	"Minors with IQ <50"*"Mortality rate minors IQ <50"	This represents the group of minors who have died.
Mortality rate minors IQ <70	Dmnl	0.002209	-	(CBS, 2021b)
Adults with IQ <50	Person	-	INTEG("Growing up minors IQ <50"-"Ageing adults IQ <50"-"Deaths adults IQ <50")	The number of adults with an IQ score below 50 in a specific year is the number of people from the previous year plus the minors who grew up minus the adults who died and the adults which aged.
Ini adults with IQ <50	Person	-	Adults*"Percentage IQ <50"	The percentage of the total adults who have an IQ score below 50.
Ageing adults with IQ <50	Person/Year	-	"Adults with IQ <50"/Ageing time	This is the number of years someone is a adults, which means until aged between 18 and 49 years old.
Deaths adults IQ <50	Person/Year	-	"Mortality rate adults IQ <70"*"Adults with IQ <50"	This represents the group of adults who have died.
Mortality rate adults IQ <70	Dmnl	0.001879	-	(CBS, 2021b)
Elderly with IQ <50	Person	-	INTEG("Ageing adults IQ <50"-"Deaths elderly IQ <50")	The number of elderly with an IQ score below 50 in a specific year is the number of people from the previous year plus the adults who grew up minus the elderly who died.
Initial elderly IQ <50	Person	-	Elderly*"Percentage IQ <50"	The percentage of the total elderly who have an IQ score below 50.
Deaths elderly IQ <70	Person/Year	-	"Elderly with IQ <50"*"Mortality rate elderly IQ <70"	This represents the group of elderly who have died.
Mortality rate elderly IQ <70	Dmnl	0.03676	-	(CBS, 2021b)

F.1.2 Population with IQ between 50 and 70

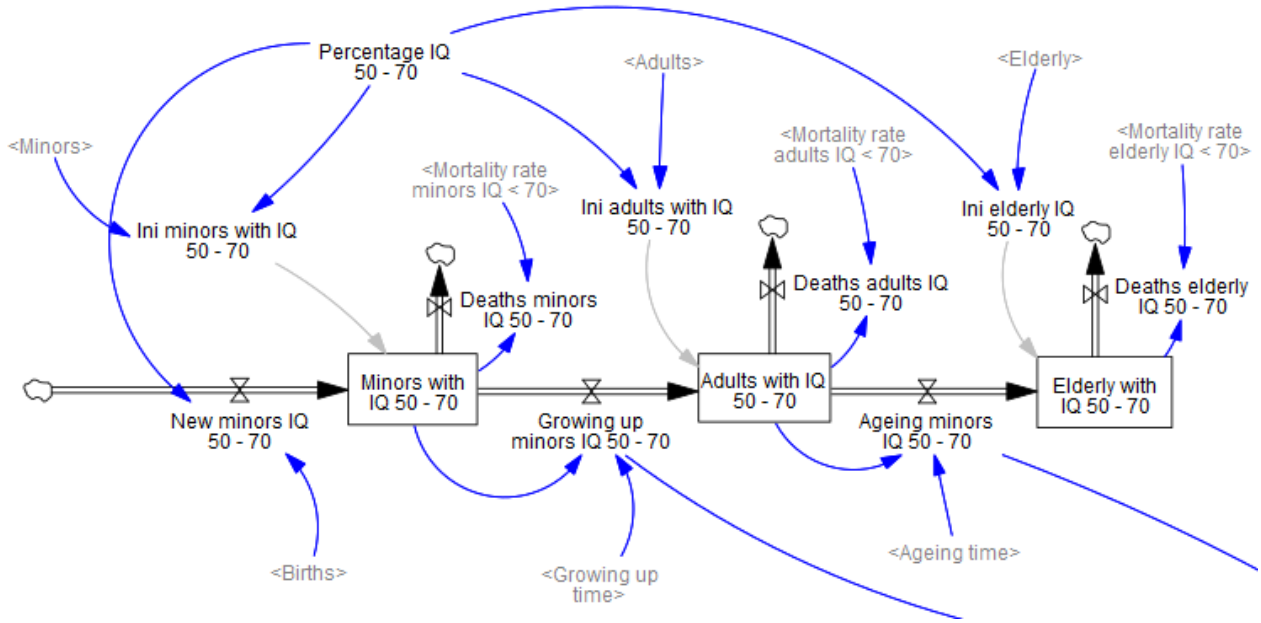


Figure 80: Overview of the model of the population with an IQ score between 50 and 70

Table 11: Overview of variables in the population model with an IQ score between 50 and 70

Variable	Unit	Value	Equation	Explanation
New minors IQ 50 – 70	Person/Year	-	"Percentage IQ 50 - 70"*Births	A part of the total births has an IQ score between 50 and 70.
Percentage IQ 50 - 70	Dmnl	0.021	-	(Ras et al., 2010)
Ini minors IQ 50 - 70	Person	-	"Percentage IQ 50 - 70"*Minors	A proportion of the minors has an IQ score between 50 and 70.
Minors with IQ 50 - 70	Person	-	INTEG("New minors IQ 50 - 70 "-"Deaths minors IQ 50 - 70 "-"Growing up minors IQ 50 - 70 ")	The number of minors with a IQ between 50 and 70 in a specific year is the number of minors from the previous year plus the new births minus the minors who died and the minors who grew up.
Deaths minors IQ 50 - 70	Person/Year	-	"Minors with IQ 50 - 70 "*"Mortality rate minors IQ 50 - 70 "	This represents the number of minors with an IQ score between 50 and 70 who dies in a specific year, based on a specific mortality rate.
Growing up minors IQ 50 - 70	Person/Year	-	"Minors with IQ 50 - 70 "/Growing up time	This is the group of minors with an IQ 50 - 70 who are growing up and becoming adults.
Ini adults IQ 50 - 70	Person	-	Adults*"Percentage IQ <50"	A proportion of the adults has an IQ between 50 and 70.
Adults with IQ 50 - 70	Person	-	INTEG("Growing up minors IQ 50 - 70 "-"Ageing minors IQ 50 - 70 "-"Deaths adults IQ 50 - 70 ")	The number of adults with an IQ score between 50 and 70 in a specific year is the number of adults from the previous year plus the new births minus the minors who died and the adults who grew up.

Deaths adults IQ 50 - 70	Person/Year	-	"Mortality rate adults IQ 50 - 70 "*"Adults with IQ 50 - 70 "	This represents the number of adults with an IQ 50 - 70 who dies in a specific year, based on a specific mortality rate.
Ageing minors IQ 50 - 70	Person/Year	-	"Adults with IQ 50 - 70 "/Ageing time	This is the group of minors with an IQ 50 - 70 who are ageing and becoming elderly.
Elderly with IQ 50 - 70	Person	-	INTEG("Ageing minors IQ 50 - 70 "-"Deaths elderly IQ 50 - 70 ")	The number of elderlies with a IQ 50 - 70 in a specific year is the number of elderly from the previous year plus the new births minus the minors who died and the elderly who grew up.
Ini elderly IQ 50 - 70	Person	-	Elderly*"Percentage IQ <50"	A proportion of the elderly has an IQ between 50 and 70.
Deaths elderly IQ 50 - 70	Person/Year	-	"Elderly with IQ 50 - 70 "*"Mortality rate elderly IQ 50 - 70 "	This represents the number of elderlies with an IQ score between 50 and 70 who dies in a specific year, based on a specific mortality rate.
Total adults pop with IQ 50 - 70	Person	-	"Ageing minors IQ 50 - 70"+"Growing up minors IQ 50 - 70"	This is the total new population above the age of 18 every year.

F.1.3 Population with IQ between 70 and 85

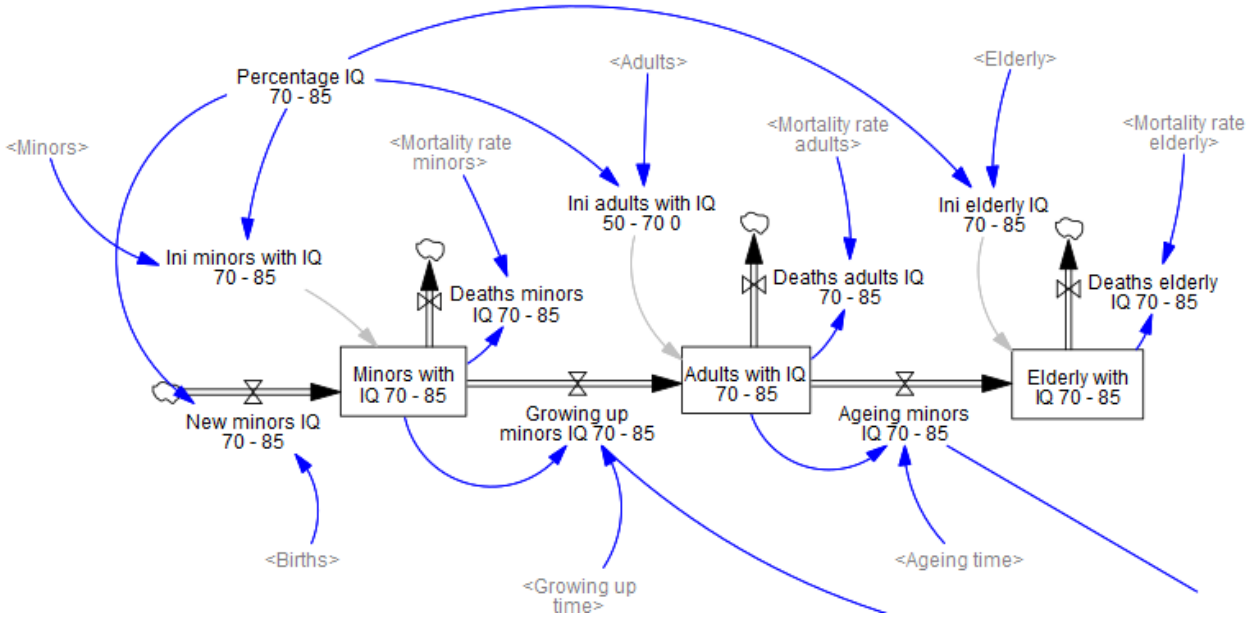


Figure 81: Overview of the model of the population with an IQ score between 70 and 85

Table 12: Overview of variables in the population model with an IQ score between 70 and 85

Variable	Unit	Value	Equation	Explanation
New minors IQ 50 – 70	Person/Year	-	"Percentage IQ 70 - 85"*Births	A part of the total births has an IQ score between 70 and 85.

Percentage IQ 70 - 85	Dmnl	0.136	-	(Ras et al., 2010)
Ini minors IQ 70 - 85	Person	-	"Percentage IQ 70 - 85"*Minors	A proportion of the minors has an IQ score between 70 and 85.
Minors with IQ 70 - 85	Person	-	INTEG("New minors IQ 70 - 85 "-"Deaths minors IQ 70 - 85 "-"Growing up minors IQ 70 - 85 ")	The number of minors with a IQ between 70 and 85 in a specific year is the number of minors from the previous year plus the new births minus the minors who died and the minors who grew up.
Deaths minors IQ 70 - 85	Person/Year	-	"Minors with IQ 70 - 85 "*"Mortality rate minors"	This represents the number of minors with an IQ score between 70 and 85 who dies in a specific year, based on a specific mortality rate.
Growing up minors IQ 70 - 85	Person/Year	-	"Minors with IQ 70 - 85 "/Growing up time	This is the group of minors with an IQ 70 - 85 who are growing up and becoming adults.
Ini adults IQ 70 - 85	Person	-	Adults*"Percentage IQ <50"	A proportion of the adults has an IQ between 70 and 85.
Adults with IQ 70 - 85	Person	-	INTEG("Growing up minors IQ 70 - 85 "-"Ageing minors IQ 70 - 85 "-"Deaths adults IQ 70 - 85 ")	The number of adults with an IQ score between 70 and 85 in a specific year is the number of adults from the previous year plus the new births minus the minors who died and the adults who grew up.
Deaths adults IQ 70 - 85	Person/Year	-	"Mortality rate adults"*"Adults with IQ 70 - 85 "	This represents the number of adults with an IQ 70 - 85 who dies in a specific year, based on a specific mortality rate.
Ageing minors IQ 70 - 85	Person/Year	-	"Adults with IQ 70 - 85 "/Ageing time	This is the group of minors with an IQ 70 - 85 who are ageing and becoming elderly.
Elderly with IQ 70 - 85	Person	-	INTEG("Ageing minors IQ 70 - 85 "-"Deaths elderly IQ 70 - 85 ")	The number of elderlies with a IQ 70 - 85 in a specific year is the number of elderly from the previous year plus the new births minus the minors who died and the elderly who grew up.
Ini elderly IQ 70 - 85	Person	-	Elderly*"Percentage IQ <50"	A proportion of the elderly has an IQ between 70 and 85.
Deaths elderly IQ 70 - 85	Person/Year	-	"Elderly with IQ 70 - 85 "*"Mortality rate elderly"	This represents the number of elderlies with an IQ score between 70 and 85 who dies in a specific year, based on a specific mortality rate.
Total adults pop with IQ 70 - 85	Person	-	"Ageing minors IQ 70 - 85"+"Growing up minors IQ 70 - 85"	This is the total new population above the age of 18 every year.

F.2 Self-reliance sub-model

F.2.1 Self-reliance IQ population with IQ score score between 50 and 70

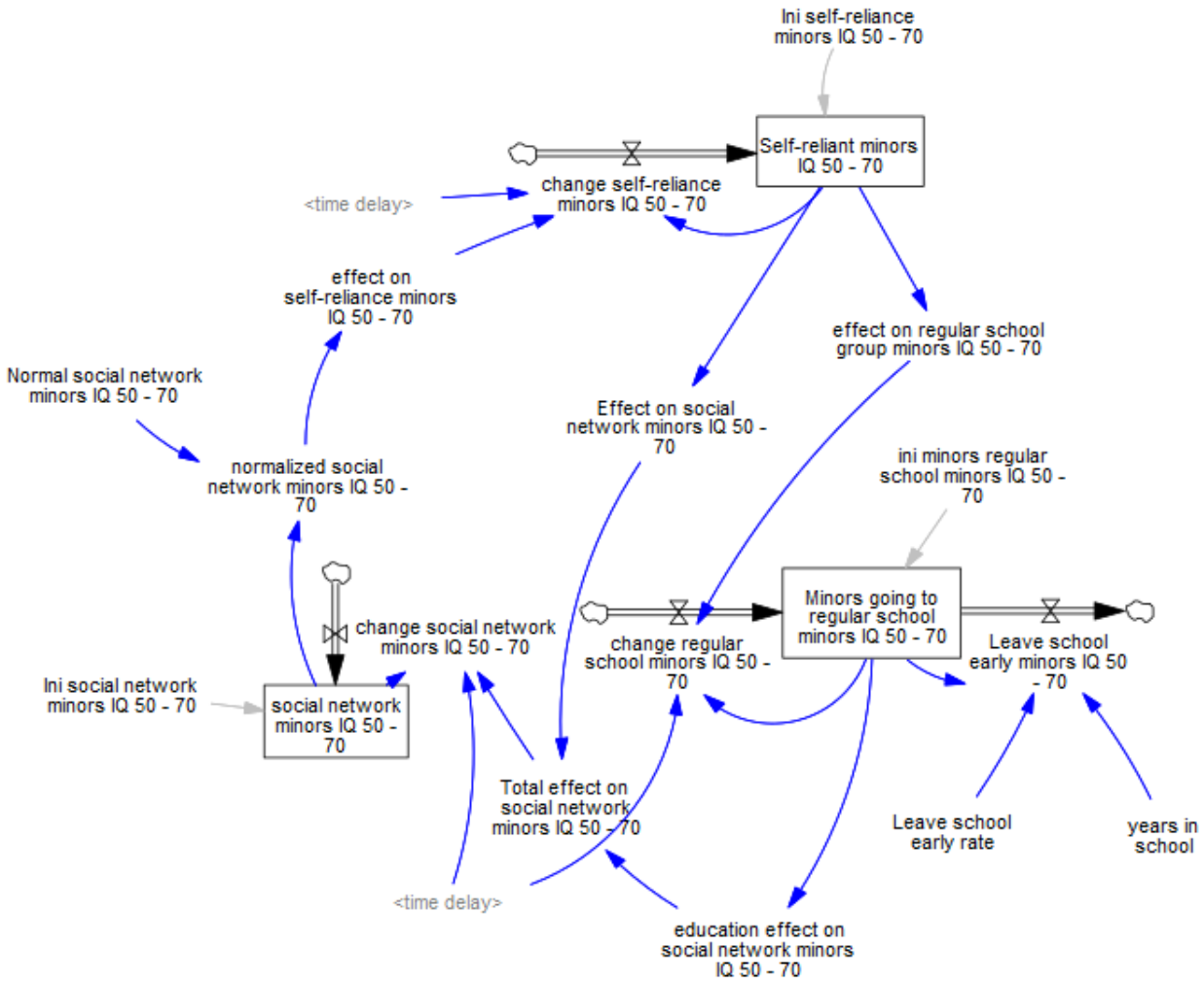


Figure 82: Overview of the model of self-reliance for minors with an IQ score between 50 and 70

Table 13: Overview of variables in the self-reliance sub-model for the minors with an IQ score between 50 and 70

Variable	Unit	Value	Equation	Explanation
Self-reliance minors IQ 50 - 70	Dmnl	"Ini self-reliance minors IQ 50 - 70"	"change self-reliance minors IQ 50 - 70"	The percentage self-reliance of minors will fluctuate a bit every year, based on the factors that influence the self-reliance of minors.
Ini self-reliance minors IQ 50 - 70	Dmnl	0.41	-	(Woittiez et al., 2019)

Change self-reliance minors IQ 50 - 70	Dmnl	-	("Self-reliant minors IQ 50 - 70"*"effect on self-reliance minors IQ 50 - 70")/time delay	The change in self-reliance is a deduction/addition based on the influence of the social network. The change has a time delay.
Time delay	Year	0.5	-	It takes some time before the change takes place.
Effect on regular school group minors IQ 50 - 70	Dmnl	-	WITH LOOKUP("Self-reliant minors IQ 50 - 70", ([(0,0)-(10,10)],(0,0),(0.2,0),(0.299,-0.005), (0.3,-0.02),(0.339,-0.02),(0.34,-0.005), (0.379,-0.005),(0.39,0),(0.46,0), (0.47,0.005),(0.57,0.005), (0.57,0),(1,0)))	Own interpretation.
change regular school minors IQ 50 - 70	Dmnl/Year	-	("Minors going to regular school minors IQ 50 - 70"*"effect on regular school group minors IQ 50 - 70")/time delay	The change in the percentage of this population who attend a regular school is influence when the self-reliance percentage changes. Here a time delay is also implemented because it takes some time before it really influences the percentages of minors attending school.
Minors going to regular school minors IQ 50 - 70	Dmnl	"ini minors regular school minors IQ 50 - 70"	"more regular school minors IQ 50 - 70"	The percentage of minors attending a regular school will becoming bigger or smaller, based on the change in group.
Ini minors IQ 50 – 70 regular school	Dmnl	0.19	-	Own interpretation (National centre of expertise, n.d.)
education effect on social network minors IQ 50 - 70	Contacts/Year	-	WITH LOOKUP("Minors going to regular school minors IQ 50 - 70", ([(0,0)-(10,10)],(0,0), (0.33,0), (0.079,-0.02),(0.08,-0.05), (0.119,-0.05),(0.12,-0.03),(0.159,-0.03), (0.16,0),(0.19,0),(0.23,0) ,(0.231,0.02), (0.26,0.02),(0.261,0), (1,0)))	Own interpretation.
Total effect on social network minors IQ 50 – 70	Dmnl	-	("education effect on social network minors IQ 50 - 70"+"Effect on social network minors IQ 50 - 70")	Both self-reliance and the percentage of minors attending a regular school influence the size of the social network. Both these effects will first be added.

Change social network minors IQ 50 - 70	Contacts/Year	-	(("social network minors IQ 50 - 70"*"Total effect on social network minors IQ 50 - 70")/time delay)	The social network will be changed based on the total effect of the factors influencing the social network, there is a delay.
Effect on social network minors IQ 50 - 70	Contacts/Year	-	WITH LOOKUP("Self-reliant minors IQ 50 - 70", ([(0,0)-(10,10)],(0,0),(0.19,0),(0.2,-0.015),(0.23,-0.035), (0.269,-0.035),(0.27,-0.02),(0.319,-0.02),(0.32,-0.01),(0.359,-0.01),(0.36,0),(0.51,0),(0.52,0.03),(0.6,0.03),(0.61,0),(1,0)))	Own interpretation.
Social network minors IQ 50 - 70	Contacts	Ini social network minors IQ 50 - 70	"change social network minors IQ 50 - 70"	The change in social network is based on the self-reliance percentage of the group and the percentage that goes to a regular school.
Ini social network minors IQ 50 - 70	Contacts	5	-	Own interpretation
Normalized social network minors IQ 50 - 70	Dmnl	-	"social network minors IQ 50 - 70"/"averaege social network minors IQ 50 - 70"	The normalized social network is based on the actual social network and the average social network.
Average social network minors IQ 50 - 70	Contacts	5	-	Own interpretation.
Effect on self-reliance minors IQ 50 - 70	Dmnl		WITH LOOKUP("normalized social network minors IQ 50 - 70", ([(0,0)- (10,10)],(0,0),(0.25,-0.005), (0.5,-0.003),(0.75,-0.002),(1,0),(1.25,0.001),(1.5,0.002),(1.75,0.004),(2,0.004),(3,0),(10,0)))	Own interpretation

Table 14: Overview of variables in the self-reliance sub-model for the adults with an IQ score between 50 and 70

Variable	**Unit**	**Value**	**Equation**	**Explanation**
Self-reliance adults IQ 50 – 70	Dmnl	Ini self-reliance adults IQ 50 – 70	"change self-reliance adults IQ 50 – 70"	The percentage self-reliance of adults will fluctuate a bit every year, based on the factors that influence the self-reliance of minors.

Ini self-reliance adults IQ 50 – 70	Dmnl	0.53	-	(Woittiez et al., 2019)
Change self-reliance adults IQ 50 – 70	Dmnl/Year	-	("Self-reliant adults IQ 50 - 70"*"Total effect on self-reliance adults IQ 50 - 70")/time delay	The change in self-reliance is a deduction/addition based on the influence of the social network and employment. The change has a time delay.
Total effect on self-reliance adults IQ 50 - 70	Dmnl	-	("Effect employment on self-reliance adults IQ 50 - 70"+"effect social network adults IQ 50 - 70 on self-reliance")	Both the percentage of adults having a job and social network influence the self-reliance. Both these effects will first be added.
Effect on employment adults IQ 50 – 70	Dmnl	-	WITH LOOKUP("Self-reliant adults IQ 50 - 70", ([(0,0)-(10,10)],(0,0), (0.29,-0.01),(0.31,-0.01), (0.34,-0.005),(0.379,-0.005),(0.38,-0.003),(0.409,-0.003), (0.42,-0.002),(0.479,-0.002), (0.48,0), (0.53,0),(0.63,0), (0.64,0.002),(0.74,0.002), (0.75,0),(1,0)))	Own interpretation.
New employment adults IQ 50 – 70	Dmnl/Year	-	("effect on employment adults IQ 50 - 70"*"Employed adults with IQ 50 - 70")/time delay	Whether new people are employed depends on the percentage of the population which is self-reliant. There is also a time delay because it takes some time before new people will be employed.
Employed adults with IQ 50 – 70	Dmnl	Ini employed adults IQ 50 – 70	"New employed adults IQ 50 – 70"-"new unemployed IQ 50 – 70"	This variable represents the percentage of adults with an IQ between 50 and 70 who have a job.
Ini employed adults IQ 50 – 70	Dmnl	0.08	-	(Eggink et al., 2020)
New unemployed IQ 50 – 70	Dmnl/Year	-	"Employed adults with IQ 50 - 70"*automation rate	This variable represent the number of people who lose a job over the years. This is partly based on the influence of self-reliance (can also get negative), but also on the automation rate. Due to automation, 'simple' job for the intellectual disability population are disappearing.

Effect employment on self-reliance IQ 50 – 70	Dmnl	-	WITH LOOKUP("Employed adults with IQ 50 - 70", ([(0,0)-(10,10)],(0,0),(0.49,0), (0.052,0), (0.549,-0.005), (0.55,-0.015), (0.06,-0.015), (0.065,-0.01), (0.068,-0.01), (0.069,-0.005), (0.074,-0.005), (0.075,0), (0.08,0),(0.1,0),(0.111,0.01), (0.18,0.01), (0.181,0), (0.5,0),(1,0)))	Own interpretation
Effect on social network adults IQ 50 – 70	Contacts/Year	-	WITH LOOKUP("Self-reliant adults IQ 50 - 70", ([(0,0)-(10,10)],(0,0),(0.35,0),(0.36,-0.0214286),(0.038,-0.0357143), (0.39,-0.0285714) , (0.42,-0.0285714) , (0.043,-0.0214286) , (0.47,-0.0214286) ,(0.499,-0.01), (0.5,0),(0.53,0),(0.58,0), (0.59,0.001),(0.64,0.001), (0.641,0),(1,0)))	Own interpretation
Change social network IQ 50 – 70	Contacts/Year	-	("social network adults IQ 50 - 70"*"Effect on social network adults IQ 50 - 70")/time delay	
Ini social network adults IQ 50 – 70	Contacts	7	-	Own interpretation
Social network adults IQ 50 – 70	Contacts	Ini social network adults IQ 50 – 70	"change social network IQ 50 – 70"	The social network can fluctuate over time, based on a changes self-reliance of the group.
Normalized social network adults IQ 50 – 70	Dmnl	-	"social network adults IQ 50 – 70"/"averaege social network adults IQ 50 – 70"	The normalized social network is based on the actual social network and the average social network.
Average social network adults IQ 50 – 70	Contacts	7	-	Own interpretation.
Effect social network adults IQ 50 – 70 on self-reliance	Dmnl	-	WITH LOOKUP("normalized social network adults IQ 50 - 70", ([(0,0)-(10,10)], (0,0),(0.25,-0.02), (0.5,-0.015), (0.75,-0.005),(1,0), (1.25,0.005),(1.5,0.01), (1.75,0.02), (2,0.02),(3,0),(10,0)))	Own interpretation.

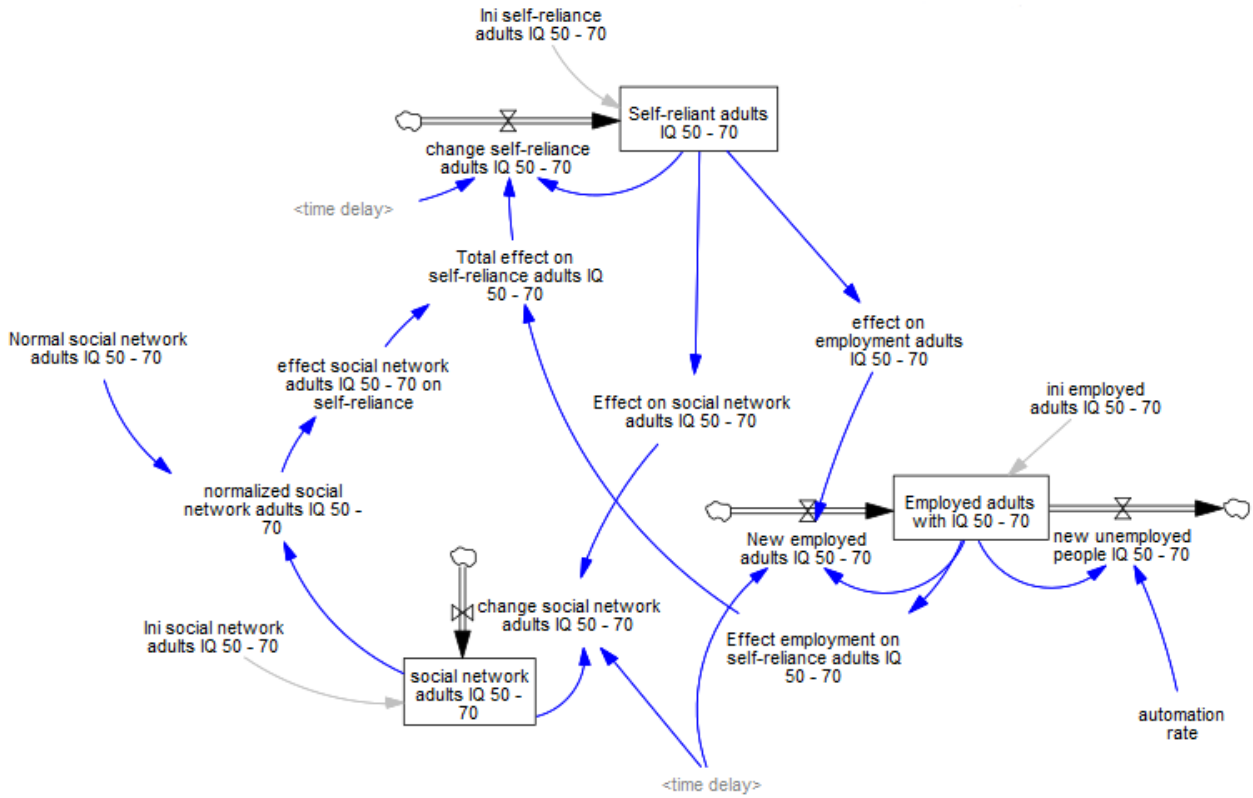


Figure 83: Overview of self-reliance sub-model for adults with an IQ score between 50 and 70

F.2.2 Self-reliance population with IQ score between 70 and 85

Table 15: Overview of variables in the self-reliance sub-model for the minors with an IQ score between 70 and 85

Variable	Unit	Value	Equation	Explanation
Self-reliance minors IQ 70 - 85	Dmnl	"Ini self-reliance minors IQ 70 - 85"	"change self-reliance minors IQ 70 - 85"	The percentage self-reliance of minors will fluctuate a bit every year, based on the factors that influence the self-reliance of minors.
Ini self-reliance minors IQ 70 - 85	Dmnl	0.63	-	(Woittiez et al., 2019)
Chance self-reliance minors IQ 70 - 85	Dmnl	-	("Self-reliant minors IQ 70 - 85"*"effect on self-reliance minors IQ 70 - 85")/time delay	The change in self-reliance is a deduction/addition based on the influence of the social network. The change has a time delay.

Effect on regular school group minors IQ 70 - 85	Dmnl	-	WITH LOOKUP("Self-reliant minors IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.439,0),(0.4,0), (0.42,-0.005),(0.459, -0.005), (0.46,-0.02), (0.5,-0.02),(0.53,-0.015), (0.559,-0.015), (0.56,-0.005),(0.599,-0.005),(0.6,0),(0.63,0), (0.68,0),(0.681,0.01), (0.72,0.01),(0.721,0),(1,0)))	Own interpretation.
change regular school minors IQ 70 - 85	Dmnl/Year	-	("Minors going to regular school minors IQ 70 - 85"*"effect on regular school group minors IQ 70 - 85")/time delay	The change in the percentage of this population who attend a regular school is influence when the self-reliance percentage changes. Here a time delay is also implemented because it takes some time before it really influences the percentages of minors attending school.
Minors going to regular school minors IQ 70 - 85	Dmnl	"ini minors regular school minors IQ 70 - 85"	"more regular school minors IQ 70 - 85"	The percentage of minors attending a regular school will becoming bigger or smaller, based on the change in group.
Ini minors IQ 70 – 85 regular school	Dmnl	0.3	-	(National centre of expertise, n.d.)
education effect on social network minors IQ 70 - 85	Contacts/Year	-	WITH LOOKUP("Minors going to regular school minors IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.3,0), (0.319,0),(0.16, 0),(0.169, -0.025),(0.17,-0.0375), (0.209,-0.0375), (0.21,-0.025), (0.259,-0.025), (0.26,0),(0.3,0), (0.34,0),(0.341,0.03125), (0.37,0.03125), (0.371,0),(1,0)))	Own interpretation
Change social network minors IQ 70 - 85	Contacts/Year	-	("social network minors IQ 70 - 85"*"total effect on social network minors 70 - 85")/time delay	The social network will be changed based on the total effect of the factors influencing the social network, there is a delay.

total effect on social network minors 70 - 85	Dmnl	-	"education effect on social network minors IQ 70 - 85"+"Effect on social network minors IQ 70 - 85"	Both self-reliance and the percentage of minors attending a regular school influence the size of the social network. Both these effects will first be added.
Effect on social network minors IQ 70 - 85	Contacts/Year	-	WITH LOOKUP("Self-reliant minors IQ 70 - 85", ([(0,0)-(10,10)],(0,0), (0.44,0),(0.459,-0.0125), (0.46,-0.0375), (0.499,-0.0375),(0.5,-0.025),(0.549,-0.025), (0.55,-0.0125),(0.589,-0.0125), (0.59,0),(0.63,0),(0.66,0.01), (0.7,0.01),(0.71,0), (1,0)))	Own interpretation.
Social network minors IQ 70 - 85	Contacts	Ini social network minors IQ 70 - 85	"change social network minors IQ 70 - 85"	The change in social network is based on the self-reliance percentage of the group and the percentage that goes to a regular school.
Ini social network minors IQ 70 - 85	Contacts	8	-	Own interpretation
Normalized social network minors IQ 70 - 85	Dmnl	-	"social network minors IQ 70 - 85"/"averaege social network minors IQ 70 - 85"	The normalized social network is based on the actual social network and the average social network.
Average social network minors IQ 70 - 85	Contacts	8	-	Own interpretation.
Effect on self-reliance minors IQ 70 - 85	Dmnl	-	WITH LOOKUP("normalized social network minors IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.25,-0.03), (0.5,-0.02),(0.75,-0.01), (1,0),(1.25,0.005),(1.5,0.01), (1.75,0.02),(2,0.02), (3,0),(10,0)))	Own interpretation.
Care-dependent minors IQ 70 - 85	Person	-	"Minors with IQ 70 - 85"*(1-"Self-reliance minors IQ 70 - 85")	The number of care-dependent minors with an IQ score between 70 and 85 is the group that is not self-reliant.

Table 16: Overview of variables in the self-reliance sub-model for the adults with an IQ score between 70 and 85

Variable	Unit	Value	Equation	Explanation
Self-reliance adults IQ 70 – 85	Dmnl	Ini self-reliance adults IQ 70 – 85	"change self-reliance adults IQ 70 – 85"	The percentage self-reliance of adults will fluctuate a bit every year, based on the factors that influence the self-reliance of minors.
Ini self-reliance adults IQ 70 – 85	Dmnl	0.7	-	(Woittiez et al., 2019)
Change self-reliance adults IQ 70 – 85	Dmnl/Year	-	("Self-reliant adults IQ 70 - 85"*"Total effect on self-reliance adults IQ 70 - 85")/time delay	The change in self-reliance is a deduction/addition based on the influence of the social network and employment. The change has a time delay.
Total effect on self-reliance adults IQ 70 - 85	Dmnl	-	"Effect employment on self-reliance adults IQ 70 - 85"+"effect social network adults IQ 70 - 85 on self-reliance"	Both the percentage of adults having a job and social network influence the self-reliance. Both these effects will first be added.
Effect on employment adults IQ 70 – 85	Dmnl	-	WITH LOOKUP("Self-reliant adults IQ 70 - 85", ([(0,0)-(10,10)],(0,0), (0.45,0), (0.5,-0.01), (0.52,-0.02), (0.559,-0.02),(0.56,-0.015),(0.619, -0.015),(0.61,-0.01),(0.659,-0.01), (0.66,0),(0.7,0), (0.8,0),(0.801,0.01), (0.85,0.01), (0.851,0),(1,0)))	Own interpretation.
New employment adults IQ 70 – 85	Dmnl/Year	-	("effect on employment adults IQ 70 - 85"*"Employed adults IQ 70 - 85")/time delay	Whether new people are employed depends on the percentage of the population which is self-reliant. There is also a time delay because it takes some time before new people will be employed.
Employed adults with IQ 70 – 85	Dmnl	Ini employed adults IQ 70 – 85	"New employed adults IQ 70 – 85"-"new unemployed IQ 70 – 85"	This variable represents the percentage of adults with an IQ between 70 and 85 who have a job.
Ini employed adults IQ 70 – 85	Dmnl	0.22	-	(Eggink et al., 2020)
New unemployed IQ 70 – 85	Dmnl/Year	-	"Employed adults with IQ 70 – 85"*automation rate	This variable represent the number of people who lose a job over the years. This is partly based on the influence of self-reliance (can also get negative), but also on the automation rate. Due to automation, 'simple' job for the intellectual disability population are disappearing.

Effect employment on self-reliance IQ 70 – 85	Dmnl	-	WITH LOOKUP("Employed adults IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.09,0), (0.1,0),(0.139,-0.015), (0.14,-0.03),(0.16,-0.03), (0.17,-0.025),(0.209,-0.025), (0.21,-0.015),(0.249,-0.015), (0.25,0),(0.28,0), (0.33,0),(0.331,0.01),(0.359,0.01), (0.4,0.015), (0.42,0.015),(0.421, 0),(1,0)))	Own interpretation.
Effect on social network adults IQ 70 – 85	Contacts/Year	-	WITH LOOKUP("Self-reliant adults IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.45,0), (0.49,0),(0.5,-0.025),(0.51,-0.045),(0.55,-0.045), (0.56,-0.035),(0.6,-0.035),(0.61,-0.025), (0.65,-0.025),(0.66,0), (0.7,0),(0.8,0), (0.801,0.01),(0.85,0.01),(0.851,0.015), (0.9,0.015), (0.901,0),(1,0)))	Own interpretation
Change social network IQ 70 – 85	Contacts/Year	-	("Effect on social network adults IQ 70 - 85"*"social network adults IQ 70 - 85")/time delay	The social network will be changed based on the total effect of the factors influencing the social network, there is a delay.
Ini social network adults IQ 70 – 85	Contacts	10	-	Own interpretation
Social network adults IQ 70 – 85	Contacts	Ini social network adults IQ 50 – 70	"change social network IQ 70 – 85"	The social network can fluctuate over time, based on a changes self-reliance of the group.
Normalized social network adults IQ 70 – 85	Dmnl	-	"social network adults IQ 70 – 85"/"averaege social network adults IQ 70 – 85"	The normalized social network is based on the actual social network and the average social network.
Average social network adults IQ 70 – 85	Contacts	10	-	Own interpretation

Effect social network adults IQ 70 – 85 on self-reliance	Dmnl	-	WITH LOOKUP("normalized social network adults IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.25,-0.015),(0.5,-0.01),(0.75,-0.005),(1,0),(1.25,0.01),(1.5,0.02),(1.75,0.03),(2,0.01),3,0),(10,0)))	Own interpretation

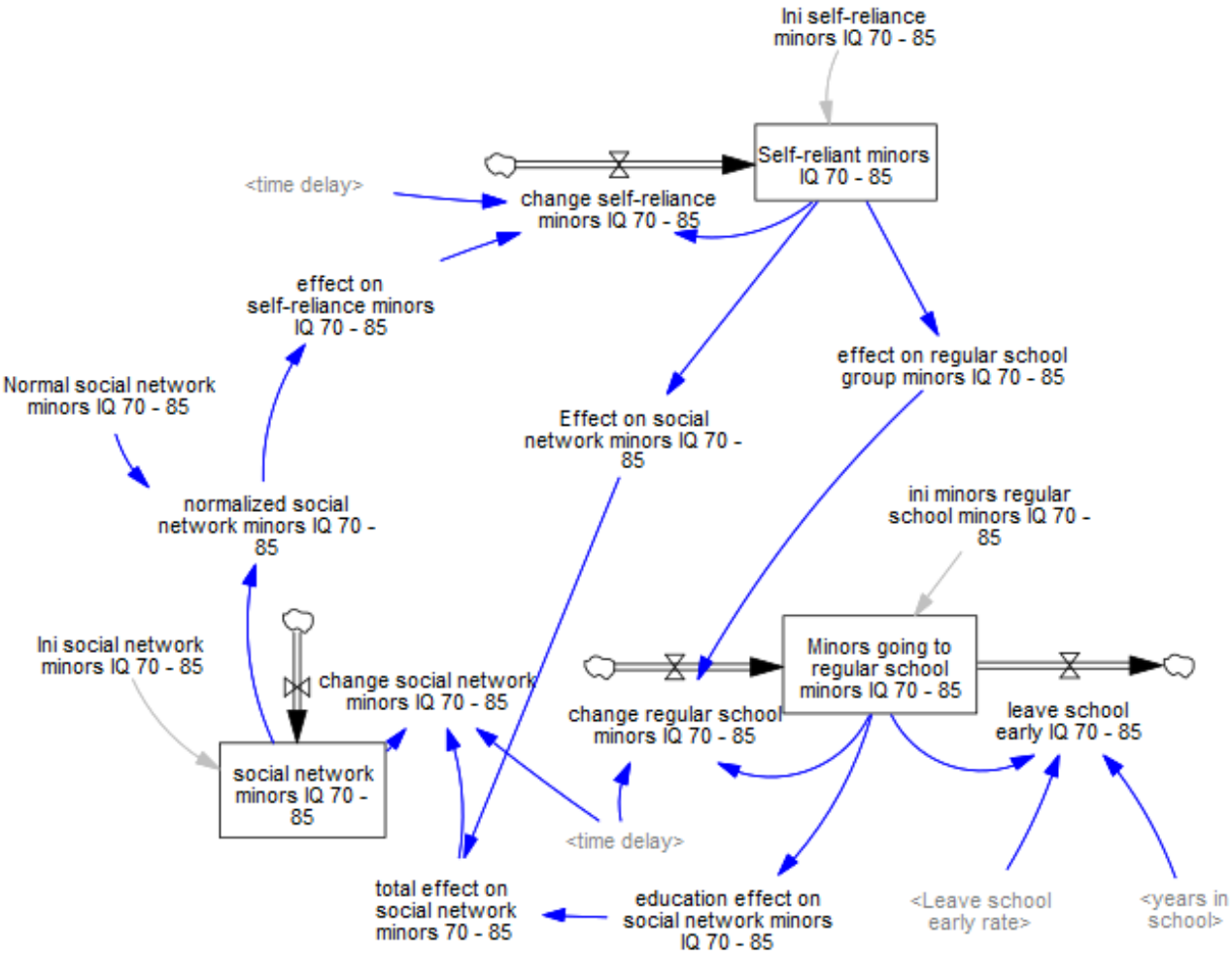


Figure 84: Overview of the self-reliance sub-model for minors with an IQ score between 70 and 85

F.3 Indication sub-model

F.3.1 Indication sub-model for the population with an IQ score below 50

Table 17: Overview of variables in the population model with an IQ score between 50 and 70

Variable	Unit	Value	Equation	Explanation
Care-dependent minors IQ <50	Person	-	INTEG("new care-dependent minors IQ <50"+"Rejected minors IQ <50"-"Growing up care-dependent minors IQ <50"-"Minors IQ <50 applying for care")	The number of care-dependent people is based the number of the previous year, the new care-dependent people, but without the people who applied for care and the ones who grew up.
New care-dependent minors IQ <50	Person/Year	-	"New minors IQ <50"*"Percentage care-dependent peope IQ <50"	The new care-dependent minors are based on the number of births with an IQ below 50 and the percentage of that group who are care-dependent.

Ini care-dependent minors IQ <50	Person	600	-	Own interpretation. The interpretation is based on the number of minors with an IQ score below 50 and the number of indications in 2015.
Percentage care-dependent people IQ <50	Dmnl	0.95	-	Almost everyone with an IQ score below 50 is care-dependent.
Growing up care-dependent minors IQ <50	Person/Year	-	"Care-dependent minors IQ <50"/Average time minors	Every year some minors grow up, which means they will not be a care-dependent minors anymore. This is based on the time someone is classified as minor.
Average time minors	Year	17	-	The years in which someone is a minor
Apply rate minors IQ <50	1/Year	0.4	-	Own interpretation.
Requests in process minors IQ <50	Person	-	INTEG("Minors IQ <50 applying for care"-"Approving indication minors IQ <50"-"Rejected minors IQ <50")	The number of requests for Wlz from minors with an IQ <50 is based the number of people who make a new request. The number of approved and rejected requests are deducted.
Ini requests in process minors IQ <50	Person	70	-	Own interpretation.
Rejected indications minors IQ <50	Person/Year	-	("Requests in process minors IQ <50"*rejection rate)/Process period	The number of requests that will be rejected is based on the number of requests in the process and the rejection rate. However, since there will be a process time for the evaluation of the requests, this will also be considered.
Rejection rate IQ	Dmnl	0.13	-	(Netherlands Court of Audit, 2018)
Delay time requests	Year	0.11538	-	In general, the CIZ has 6 weeks to analyse a request. (CIZ, n.d.-c)
Approved requests IQ <50	Person/Year	-	("Requests in process IQ <50"*(1-"Rejection rate IQ <50"))/Delay time requests	The number of approved requests is based on the number percentage that will be approved, and the time it takes to process the request.
Number of indications minors IQ <50	Person	-	INTEG("Approving indication minors IQ <50"-"growing up minors IQ <50 with indication")	The number of indications is equal to the number of indications of the previous year plus the new granted indications. The number of minors who grew up were subtracted.

Ini number of indications minors IQ <50	Person	1800	-	(CIZ, 2023)
Growing up minors IQ <5 with indication	Person/Year	-	"Number of indication minors IQ <50"/Average time minors	Minors will have the indication that is granted for the time they are classified as minors
Care-dependent adults IQ <50	Person	-	INTEG("new care-dependent adults IQ <50"+"Rejected adults IQ <50"-"Adults IQ <50 applying for care"-"Deceases care-dependent adults IQ <50")	The number of care-dependent adults is based the number of the previous year, the new care-dependent adults, but without the adults who applied for care and the ones who deceased.
New care-dependent adults IQ <50	Person/Year	-	"Growing up minors IQ <50"*"Percentage care-dependent people IQ <50"	The number of new care-dependent adults is based on the number of minors who grew up and the percentage which is care-dependent.
Ini care-dependent adults IQ <50	Person	1300	-	Own interpretation.
Deceased care-dependent adults IQ <50	Person/Year	-	"Care-dependent adults IQ <50"/"Average age adults IQ <50"	The number of people who deceased but did not have a Wlz indication.
Average time adults IQ <50	Year	42	-	On average, someone with an IQ score below 50, the age of mortality is 60. So when they become adults, they still have around 42 years to live.
Apply rate adults IQ <50	1/Year	0.95	-	Own interpretation. CIZ said this is true
Requests in process adults IQ <50	Person	-	INTEG("Adults IQ <50 applying for care"-"approving indication adults IQ <50"-"Rejected adults IQ <50"	The number of requests for Wlz from adults with an IQ <50 is based the number of people who make a new request. The number of approved and rejected requests are deducted.
Ini requests in process adults IQ <50	Person	300	-	Own interpretation.

Rejected indications adults IQ <50	Person/Year	-	("Requests in process minors IQ <50"*rejection rate)/Process period	The number of requests that will be rejected is based on the number of requests in the process and the rejection rate. However, since there will be a process time for the evaluation of the requests, this will also be considered.
Approved indications adults IQ <50	Person/Year	-	("Requests in process adults IQ <50"*rejection rate)/Process period	The number of approved requests is based on the number percentage that will be approved, and the time it takes to process the request.
Number of indications adults IQ <50	Person	-	INTEG("approving indication adults IQ <50"-"Deceased adults IQ <50 with indication"	The number of indications is equal to the number of indications of the previous year plus the new granted indications. The number adults who diseased were subtracted.
Ini number of indications adults IQ <50	Person	6520	-	(CIZ, 2023)
Deceased adults IQ <50 with indication	Person/Year	-	"Number of indications adults IQ <50"/"Average age adults IQ <50"	adults will have the indication that is granted until they deceased
Shortage in institutional places for people IQ <50	Person	-	"capacity IQ <50"-(("Number of indication minors IQ <50"+"Number of indications adults IQ <50")*"percentage people living in institution IQ <50")	The shortage in places are the difference between the capacity and the number of indications.
Percentage people living in institution IQ <50	Dmnl	0.9	-	Own interpretation. AT osborne
Capacity IQ <50	Person	9500	-	(CBS, 2023)

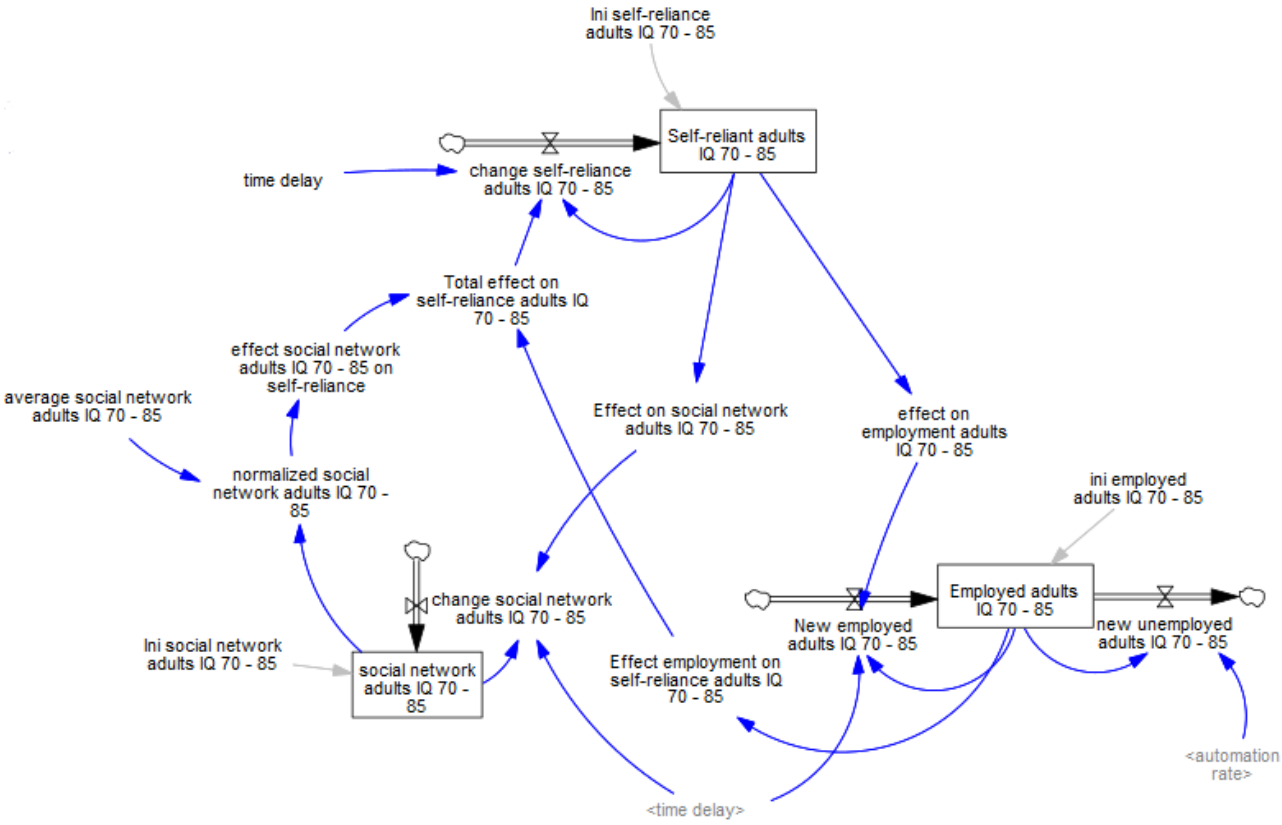


Figure 85: Overview of the self-reliance sub-model for adults with an IQ score between 70 and 85

F.3.2 Indication sub-model for the population with an IQ score between 50 and 70

Table 18: Overview of variables in the population model with an IQ score between 50 and 70

Variable	Unit	Value	Equation	Explanation
Care-dependent minors IQ 50 - 70	Person	-	INTEG("new care-dependent minors IQ 50 - 70"+"Rejected minors IQ 50 - 70"-"Growing up care-dependent minors IQ 50 - 70"-"Minors IQ 50 - 70 applying for care")	The number of care-dependent people is based the number of the previous year, the new care-dependent people, but without the people who applied for care and the ones who grew up.
New care-dependent minors IQ 50 - 70	Person/Year	-	"New minors IQ 50 - 70"*(1-"Self-reliant minors IQ 50 - 70")	The new care-dependent minors are based on the number of births with an IQ between 50 and 70 and the percentage of that group who are not self-reliant.
Ini care-dependent minors IQ 50 - 70	Person	7000	-	Own interpretation. The interpretation is based on the number of minors with an IQ score between 50 and 70 and the number of indications in 2015.

Growing up care-dependent minors IQ 50 - 70	Person/Year	-	"Care-dependent minors IQ 50 - 70"/Average time minors	Every year some minors grow up, which means they will not be a care-dependent minors anymore. This is based on the time someone is classified as minor.
Average time minors	Year	17	-	The years in which someone is a minor
Apply rate minors IQ 50 - 70	1/Year	0.2	-	Own interpretation.
Requests in process minors IQ 50 - 70	Person	-	INTEG("Minors IQ 50 - 70 applying for care"-"Approving indication minors IQ 50 - 70"-"Rejected minors IQ 50 - 70")	The number of requests for Wlz from minors with an IQ 50 - 70 is based the number of people who make a new request. The number of approved and rejected requests are deducted.
Ini requests in process minors IQ 50 - 70	Person	254	-	Own interpretation.
Rejected indications minors IQ 50 - 70	Person/Year	-	("Requests in process minors IQ 50 - 70"*rejection rate)/Process period	The number of requests that will be rejected is based on the number of requests in the process and the rejection rate. However, since there will be a process time for the evaluation of the requests, this will also be considered.
Approved requests IQ 50 - 70	Person/Year	-	("Requests in process IQ 50 - 70"*(1-"Rejection rate IQ 50 - 70"))/Delay time requests	The number of approved requests is based on the number percentage that will be approved, and the time it takes to process the request.
Number of indications minors IQ 50 - 70	Person	-	INTEG("Approving indication minors IQ 50 - 70"-"growing up minors IQ 50 - 70 with indication")	The number of indications is equal to the number of indications of the previous year plus the new granted indications. The number of minors who grew up were subtracted.
Ini number of indications minors IQ 50 - 70	Person	6215	-	(CIZ, 2023)
Growing up minors IQ 50 - 70 with indication	Person/Year	-	"Number of indication minors IQ 50 - 70"/Average time minors	Minors will have the indication that is granted for the time they are classified as minors

Care-dependent adults IQ 50 - 70	Person	-	INTEG("new care-dependent adults IQ 50 - 70"+"Rejected adults IQ 50 - 70"-"Adults IQ 50 - 70 applying for care"-"Deceases care-dependent adults IQ 50 - 70")	The number of care-dependent adults is based the number of the previous year, the new care-dependent adults, but without the adults who applied for care and the ones who deceased.
New care-dependent adults IQ 50 - 70	Person/Year	-	(1-"Self-reliant adults IQ 50 - 70")*"Growing up minors IQ 50 - 70"	The number of new care dependent adults is based on the number of minors who grew up and the percentage which is care-dependent.
Ini care-dependent adults IQ 50 - 70	Person	10000	-	Own interpretation.
Deceased care-dependent adults IQ 50 - 70	Person/Year	-	"Care-dependent adults IQ 50 - 70"/"Average age adults IQ 50 - 70"	The number of people who deceased but did not have an Wlz indication.
Average time adults IQ 50 - 70	Year	46	-	On average, someone with an IQ score between 50 and 70, the age of mortality is 60. So when they become adults, they still have around 42 years to live.
Apply rate adults IQ 50 - 70	1/Year	0.5	-	Own interpretation. CIZ said this is true
Requests in process adults IQ 50 - 70	Person	-	INTEG("Adults IQ 50 - 70 applying for care"-"approving indication adults IQ 50 - 70"-"Rejected adults IQ 50 - 70"	The number of requests for Wlz from adults with an IQ 50 - 70 is based the number of people who make a new request. The number of approved and rejected requests are deducted.
Ini requests in process adults IQ 50 - 70	Person	754	-	Own interpretation.
Rejected indications adults IQ 50 - 70	Person/Year	-	("Requests in process minors IQ 50 - 70"*rejection rate)/Process period	The number of requests that will be rejected is based on the number of requests in the process and the rejection rate. However, since there will be a process time for the evaluation of the requests, this will also be considered.
Approved indications adults IQ 50 - 70	Person/Year	-	("Requests in process adults IQ <50"*rejection rate)/Process period	The number of approved requests is based on the number percentage that will be approved, and the time it takes to process the request.

Number of indications adults IQ 50 - 70	Person	-	INTEG("approving indication adults IQ 50 - 70"-"Deceased adults IQ 50 - 70 with indication"	The number of indications is equal to the number of indications of the previous year plus the new granted indications. The number adults who diseased were subtracted.
Ini number of indications adults IQ 50 - 70	Person	33615	-	(CIZ, 2023)
Deceased adults IQ 50 - 70 with indication	Person/Year	-	"Number of indications adults IQ 50 - 70"/"Average age adults IQ 50 - 70"	adults will have the indication that is granted until they deceased
Shortage in institutional places for people IQ 50 - 70	Person	-	"capacity IQ 50 - 70"-(("Number of indication minors IQ 50 - 70"+"Number of indications adults IQ 50 - 70")*"percentage people living in institution IQ 50 - 70")	The shortage in places are the difference between the capacity and the number of indications.
Percentage people living in institution IQ 50 - 70	Dmnl	0.6	-	Own interpretation. AT osborne
Capacity IQ 50 - 70	Person	48490	-	(CBS, 2023)

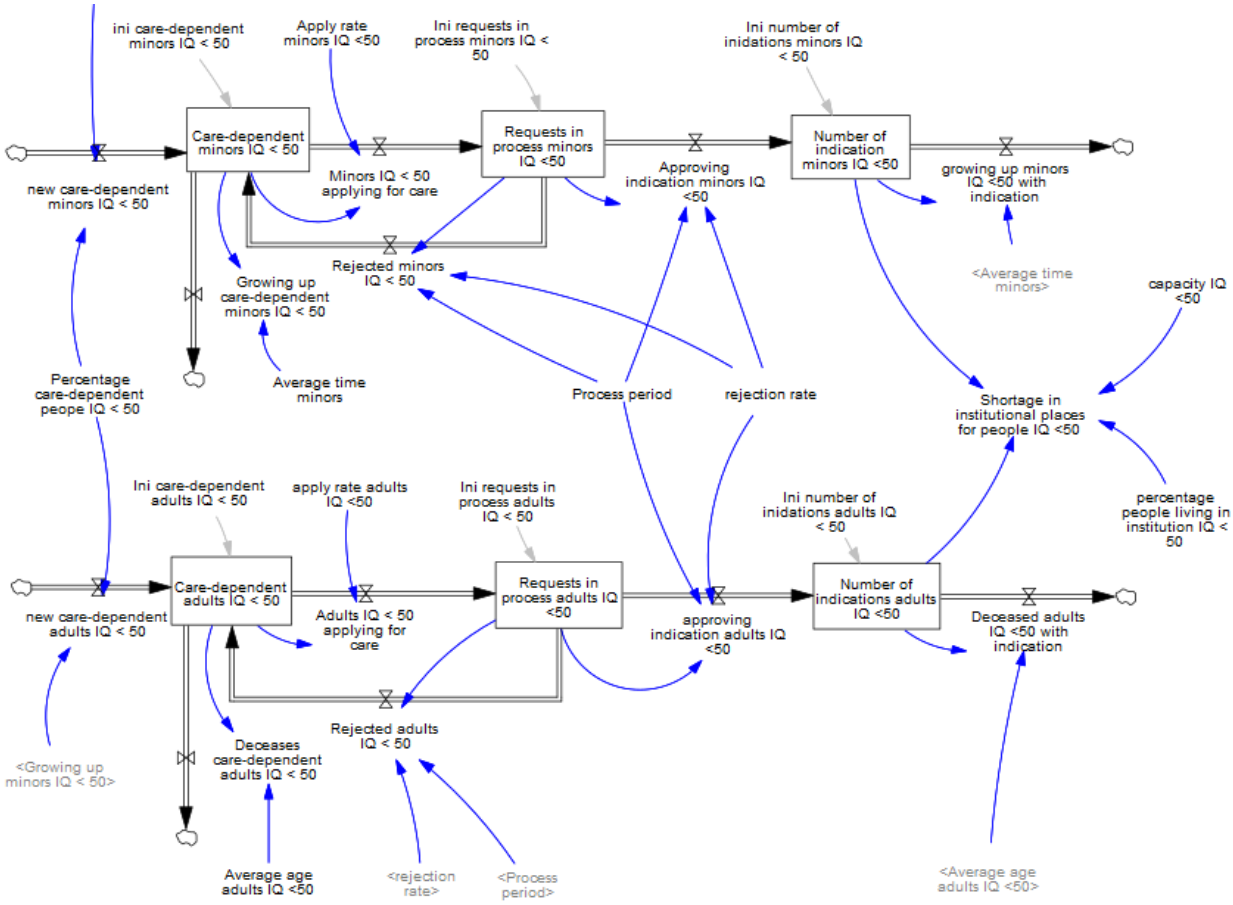


Figure 86: Overview of indications sub-model for the population with an IQ below 50

F.3.3 Indication sub-model for the population with an IQ score between 70 and 85

Table 19: Overview of variables in the population model with an IQ score between 50 and 70

Variable	Unit	Value	Equation	Explanation
Care-dependent minors IQ 70 - 85	Person	-	INTEG("new care-dependent minors IQ 70 - 85"+"Rejected minors IQ 70 - 85"-"Growing up care-dependent minors IQ 70 - 85"-"Minors IQ 70 - 85applying for care")	The number of care-dependent people is based the number of the previous year, the new care-dependent people, but without the people who applied for care and the ones who grew up.
New care-dependent minors IQ 70 - 85	Person/Year	-	"New minors IQ 70 - 85"*(1-"Self-reliant minors IQ 70 - 85")	The new care-dependent minors are based on the number of births with an IQ between 70 and 85 and the percentage of that group who are not self-reliant.
Ini care-dependent minors IQ 70 - 85	Person	40000	-	Own interpretation. The interpretation is based on the number of minors with an IQ score between 70 and 85 and the number of indications in 2015.

Growing up care-dependent minors IQ 70 - 85	Person/Year	-	"Care-dependent minors IQ 70 - 85"/Average time minors	Every year some minors grow up, which means they will not be a care-dependent minors anymore. This is based on the time someone is classified as minor.
Average time minors	Year	17	-	The years in which someone is a minor
Apply rate minors IQ 70 - 85	1/Year	0.01	-	Own interpretation.
Requests in process minors IQ 70 - 85	Person	-	INTEG("Minors IQ 70 - 85applying for care"-"Approving indication minors IQ 70 - 85"-"Rejected minors IQ 70 - 85")	The number of requests for Wlz from minors with an IQ 70 – 85 is based the number of people who make a new request. The number of approved and rejected requests are deducted.
Ini requests in process minors IQ 70 - 85	Person	200	-	Own interpretation.
Rejected indications minors IQ 70 - 85	Person/Year	-	("Requests in process minors IQ 70 - 85"*rejection rate)/Process period	The number of requests that will be rejected is based on the number of requests in the process and the rejection rate. However, since there will be a process time for the evaluation of the requests, this will also be considered.
Approved requests IQ 70 - 85	Person/Year	-	("Requests in process IQ 70 - 85"*(1-"Rejection rate IQ 70 - 85"))/Delay time requests	The number of approved requests is based on the number percentage that will be approved, and the time it takes to process the request.
Number of indications minors IQ 70 - 85	Person	-	INTEG("Approving indication minors IQ 70 - 85"-"growing up minors IQ 70 – 85 with indication")	The number of indications is equal to the number of indications of the previous year plus the new granted indications. The number of minors who grew up were subtracted.
Ini number of indications minors IQ 70 - 85	Person	2665	-	(CIZ, 2023)
Growing up minors IQ 70 – 85 with indication	Person/Year	-	"Number of indication minors IQ 50 - 70"/Average time minors	Minors will have the indication that is granted for the time they are classified as minors

Care-dependent adults IQ 70 - 85	Person	-	INTEG("new care-dependent adults IQ 70 - 85"+"Rejected adults IQ 70 - 85"-"Adults IQ 70 - 85 applying for care"-"Deceases care-dependent adults IQ 70 - 85")	The number of care-dependent adults is based the number of the previous year, the new care-dependent adults, but without the adults who applied for care and the ones who deceased.
New care-dependent adults IQ 70 - 85	Person/Year	-	(1-"Self-reliant adults IQ 70 - 85")*"Growing up minors IQ 70 - 85"	The number of new care dependent adults is based on the number of minors who grew up and the percentage which is care-dependent.
Ini care-dependent adults IQ 70 - 85	Person	150000	-	Own interpretation.
Deceased care-dependent adults IQ 70 - 85	Person/Year	-	"Care-dependent adults IQ 70 - 85"/"Average age adults 70 - 85"	The number of people who deceased but did not have an Wlz indication.
Average time adults IQ 70 - 85	Year	52	-	On average, someone with an IQ score between 70 and 85, the age of mortality is 70. So when they become adults, they still have around 52 years to live.
Apply rate adults IQ 70 - 85	1/Year	0.15	-	Own interpretation. CIZ said this is true
Requests in process adults IQ 70 - 85	Person	-	INTEG("Adults IQ 70 – 85 applying for care"-"approving indication adults IQ 70 - 85"-"Rejected adults IQ 70 - 85"	The number of requests for Wlz from adults with an IQ 70 - 85 is based the number of people who make a new request. The number of approved and rejected requests are deducted.
Ini requests in process adults IQ 70 - 85	Person	2000	-	Own interpretation.
Rejected indications adults IQ 70 - 85	Person/Year	-	("Requests in process minors IQ 70 - 85"*rejection rate)/Process period	The number of requests that will be rejected is based on the number of requests in the process and the rejection rate. However, since there will be a process time for the evaluation of the requests, this will also be considered.
Approved indications adults IQ 70 - 85	Person/Year	-	("Requests in process adults IQ 70 - 85"*rejection rate)/Process period	The number of approved requests is based on the number percentage that will be approved, and the time it takes to process the request.

Number of indications adults IQ 70 - 85	Person	-	INTEG("approving indication adults IQ 70 - 85"-"Deceased adults IQ 70 - 85 with indication")	The number of indications is equal to the number of indications of the previous year plus the new granted indications. The number adults who diseased were subtracted.
Ini number of indications adults IQ 70 - 85	Person	45527	-	(CIZ, 2023)
Deceased adults IQ 70 – 85 with indication	Person/Year	-	"Number of indications adults IQ 70 - 85"/"Average age adults IQ 70 – 85"	adults will have the indication that is granted until they deceased
Shortage in institutional places for people IQ 70 - 85	Person	-	"capacity IQ 70 - 85"-(("Number of indication minors IQ 70 - 85"+"Number of indications adults IQ 70 - 85")*"percentage people living in institution IQ 70 - 85")	The shortage in places are the difference between the capacity and the number of indications.
Percentage people living in institution IQ 70 - 85	Dmnl	0.3	-	Own interpretation. AT osborne
Capacity IQ 70 - 85	Person	48635	-	(CBS, 2023)

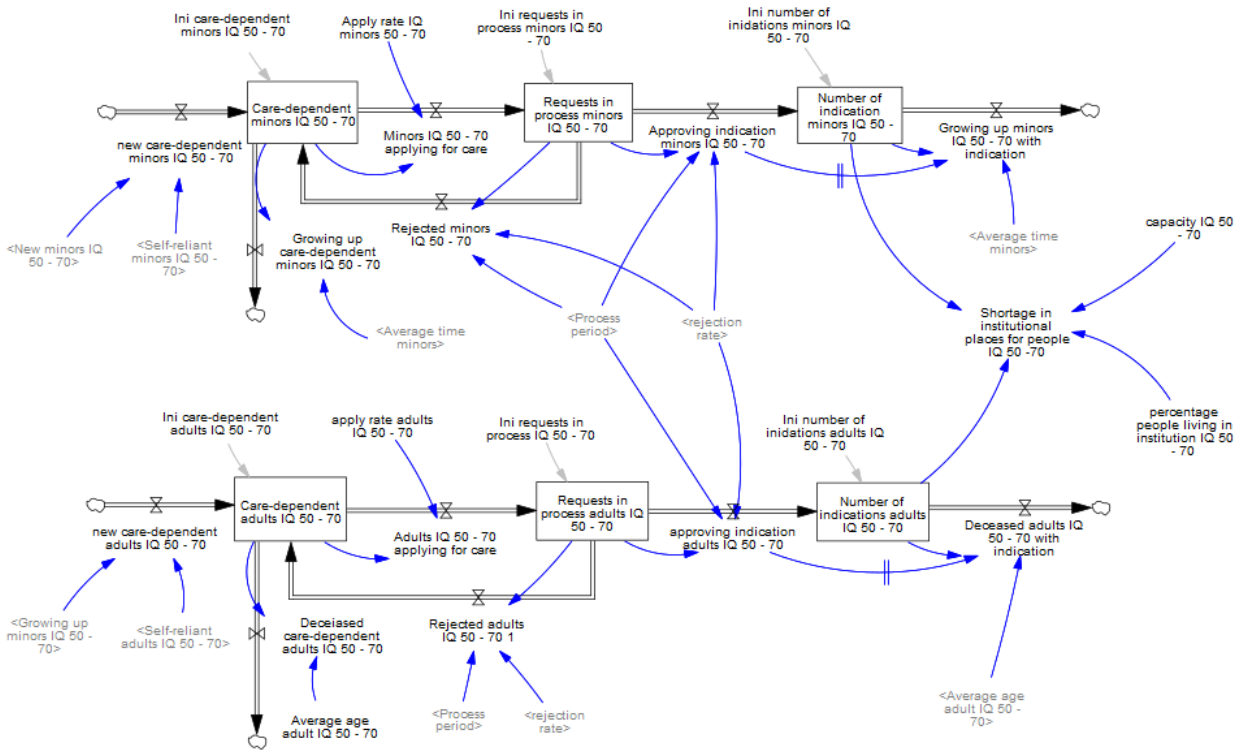


Figure 87: Overview of indications sub-model for the population with an IQ between 50 and 70

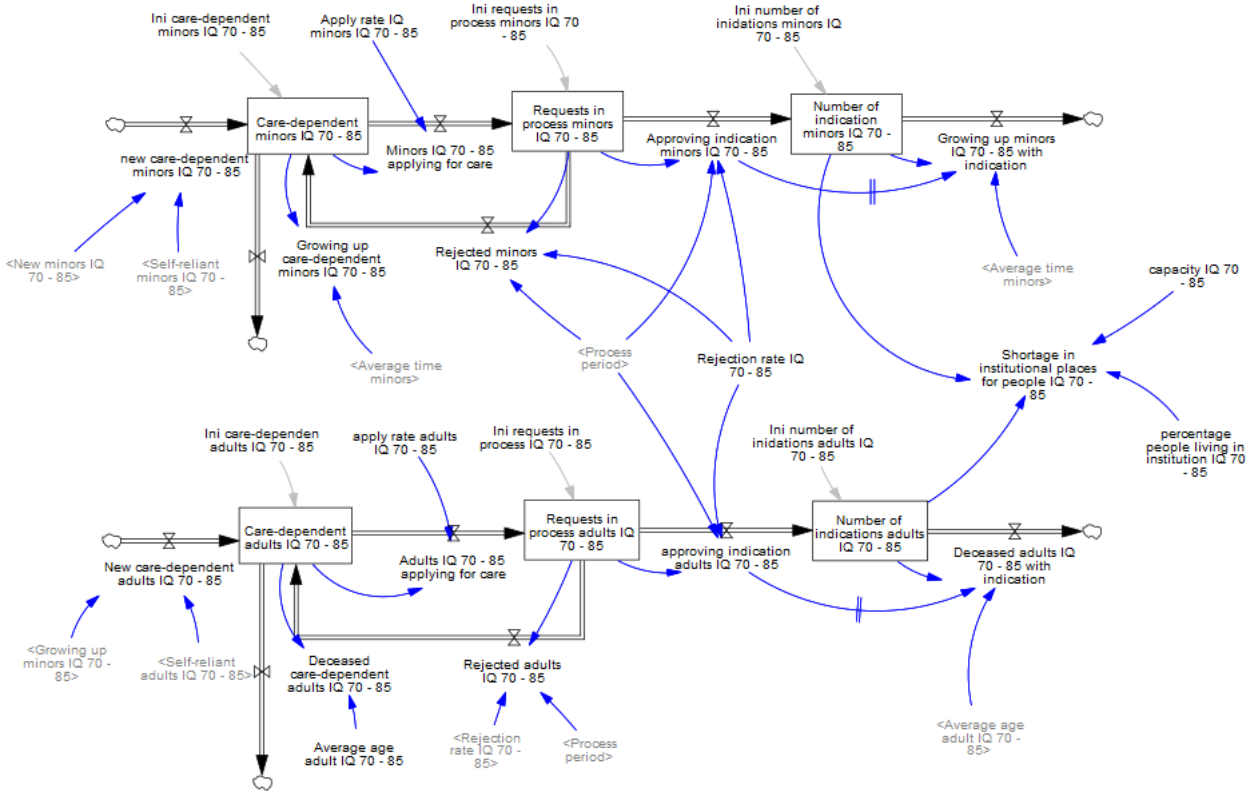


Figure 88: Overview of indications sub-model for the population with an IQ between 70 and 85

G Model Evaluation

G.1 Model verification

Model verification is about checking whether the model is coded correctly and consistently. For the model verification, three different tests will be done: correctness of the coding, dimension analysis, and numerical errors.

G.1.1 Correctness of the coding

For this test, there will be looked at the equations and values. A first check will be investigating whether there are variables which can reach an outcome below zero. For this model, in which most variables are measured in the number of persons or percentages, this is not possible. There was found that in the self-reliance sub-model, the stocks could reach a value below zero. This is incorrect and indicated a structural error. To solve this error in the model, the change in variables was coded differently. There was chosen to implement softmax/softmin method within these functions, which made sure the values could not go lower than 0.

G.1.2 Dimension analysis

The dimensional check of the model consists of evaluating the units of all the variables. Two steps need to be taken to make sure the models are modelled correctly. The first one is making sure all the variables have a unit that fits the real-world representation of the model. In this model that means that the population sub-model should be modelled in the number of persons. This is checked for the whole model and can be confirmed as consistent.

The other check can be done with the 'Units Check' function within Vensim. This function checks whether all the units that have been put in the model are correct with the equations used for the variables. When performing the unit check within the intellectual disability model, all units are OK.

G.1.3 Numerical errors

For the numerical errors, two different checks need to be performed, the time step check, and the method check. The choice of the time step is very important for the accuracy and calculation time of the model. The smaller the time step, the more accurate the model. To test whether the right time step was used for the model to run the model a few times, every time with half the time step. Once the results from the model do not change a lot with a smaller time step, the right time step has been found. For the intellectual disability model, the model has been run a few times, and eventually, the time step of 0.03125 has been found. In figure 89 these runs are shown for the KPI shortage in institutional places for people IQ 50 - 70. Once the time step got the value of 0.03125 or lower, there were no changes in the result.

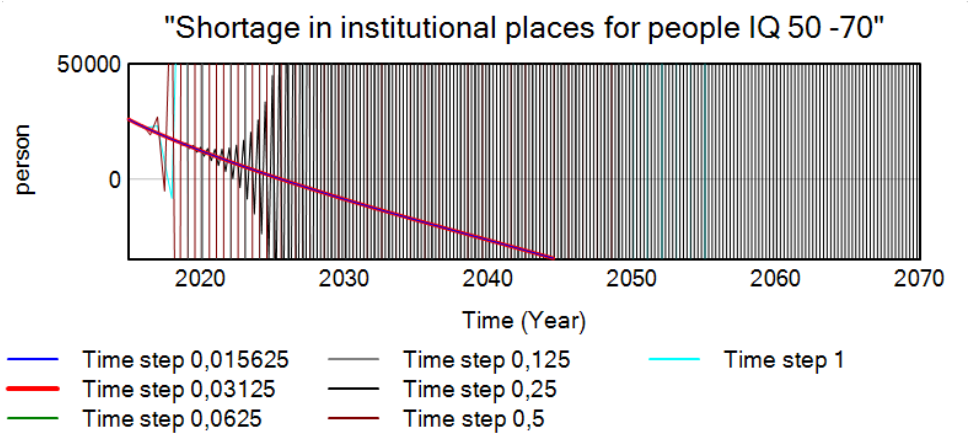


Figure 89: Time step verification

The method check is to find out whether the right method in Vensim is used to simulate the model. Within Vensim there are two kinds of methods that can be used, the Euler method, and the Runge-Kutta methods. The Eurler method is used for

a discontinuous model, and the Runge-Kutta methods are used when the model is continuous. This model is not using continuous functions, and next to this, step functions are used and therefore the Euler method is used.

G.2 Model Validation

G.2.1 Extreme conditions test

The extreme conditions test is a direct structure test, that explores the behaviour of the model under extreme conditions for some input variables (Pruyt, 2013). With these results, there can be determined whether the results are logically compared to the knowledge or expectations about the real situation. It will also help identify flaws, non-linearities, and asymptotes of the model structure. There will be looked at the influence of the extreme values on the KPIs of the model, as mentioned in paragraph 3. Since the KPIs can be split up over three IQ groups, the extreme value tests will also be divided into three separate parts, one for every IQ group.

population IQ score below 50 The group of people with an IQ score below 50, is the smallest of the three IQ groups. Next to that, their IQ is too low to be self-reliant, and this group will always need care and support. Therefore, the KPI self-reliant is not applicable to this group, and only the shortage of institutional places will be considered during the extreme conditions test.The parameters changed for the extreme conditions test is shown in table 20

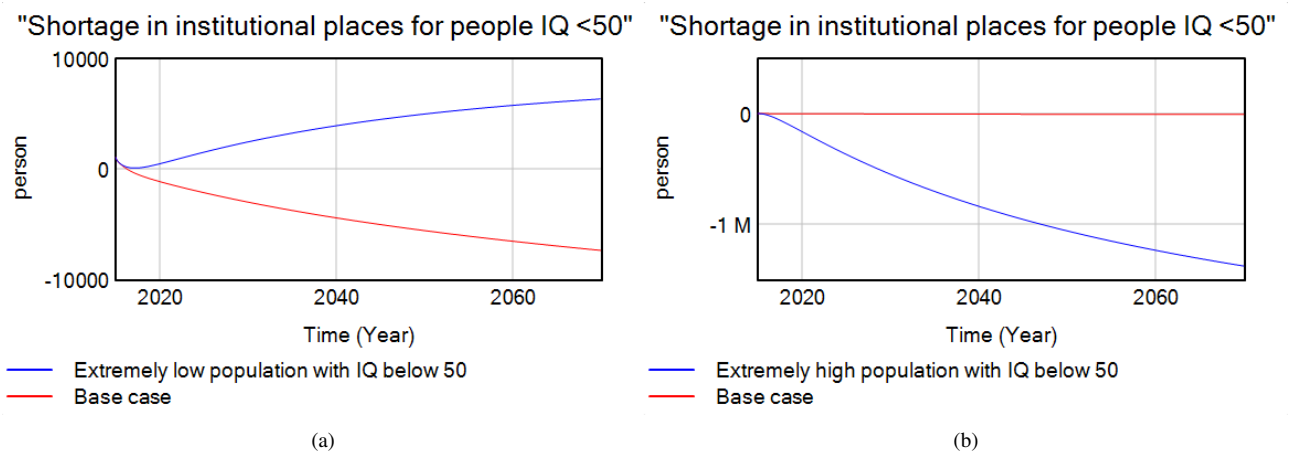
Table 20: Parameter varied in the extreme conditions test IQ < 50

Input parameter	Base case value	Extremely low value	Extremely high value
Percentage IQ < 50	0.001	0.00001	0.1

.

The model will be tested for the population with an IQ score below 50 being 0. Considering the extremely high value for the population, there will be looked at the IQ score below 50 population being 10% of the total population. The parameter *Percentage IQ < 50* will be used for this test. Another parameter that will be tested for the population with an IQ below 50 is the application rate of the population for care from Wlz. The parameters that will be varied for this test are *Apply rate minors IQ < 50* and *Apply rate adults IQ < 50*.

With an extremely low and extremely high population with an IQ score below 50, it was expected the shortage of institutional places for this IQ group was no deficit or even larger shortages in institutional places. As seen in figure 90a and figure 90b, this expectation occurred. If there are almost no people with an IQ below 50, this will lead to almost no new granted indications and enough institutional places for this IQ group. The opposite happened with an extremely high group of people with an IQ score below 50, there the shortage will increase extremely.



(a) (b)

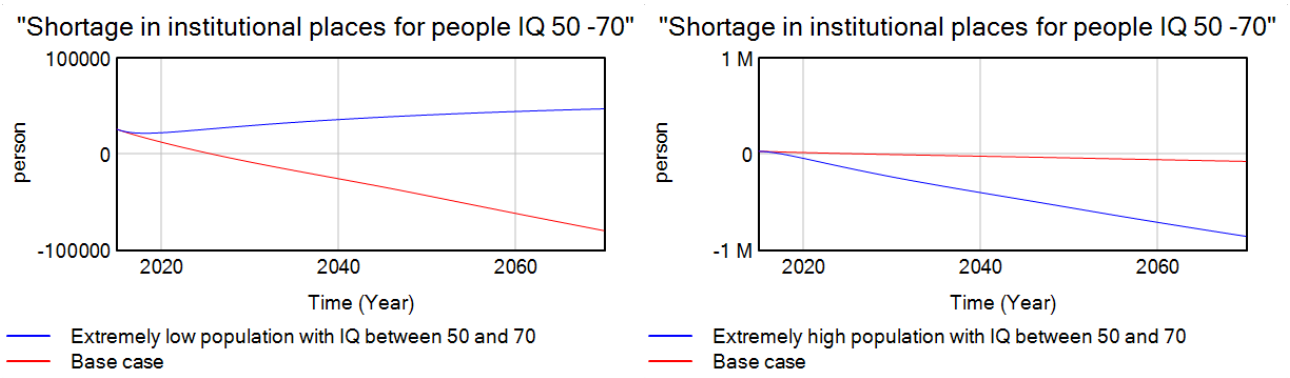
Figure 90: The shortage of institutional places with an extremely (a) low or (b) high population with an IQ score below 50

Population IQ score between 50 and 70 For the population with an IQ score between 50 and 70, the self-reliance of the group does influence the number of people who will apply for care. Therefore both the KPIs can be compared for this group. All parameters changed to extremely low and extremely high values are shown in table 21, including the base case value.

Table 21: Overview parameters varied in the extreme conditions test IQ between 50 and 70

Input parameter	**Base case value**	**Extremely low value**	**Extremely high value**
Percentage IQ 50 - 70	0.021	0.00001	0.15
change self-reliance minors IQ 50 - 70	"Self-reliant minors IQ 50 - 70"*"effect on self-reliance minors IQ 50 - 70")/time delay	Base case * 0.1	Base case * 2
Change self-reliance adults IQ 50 - 70	"Self-reliant adults IQ 50 - 70"*"Total effect on self-reliance adults IQ 50 - 70")/time delay	Base case * 0.1	Base case * 2

The first test will be changing the population with an IQ between 50 and 70 to an extremely low and extremely high value. The group will be set to almost zero and to 15%. There is, again, expected that the shortage will be non-existence or even more. The results of the tests are shown in figure 91a and figure 91b. The results show the behaviour as was expected.



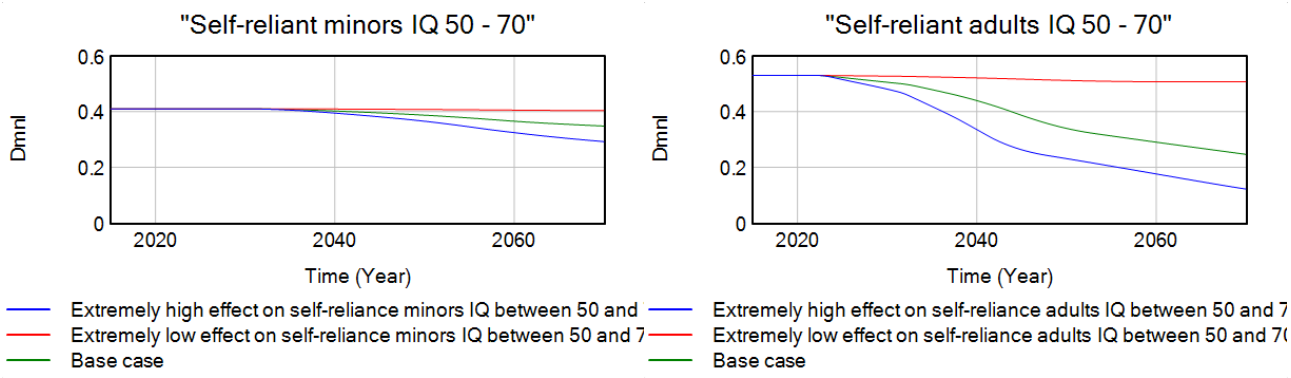
(a) (b)

Figure 91: The shortage of institutional places with an extremely (a) low or (b) high population with an IQ score between 50 and 70

After that, the self-reliance KPI will be used for the univariate sensitivity analysis. To influence the model with extreme values, there is chosen to influence the *change self-reliance minors IQ 50 - 70* and *change self-reliance adults IQ 50 - 70* to put under extreme conditions. For this, the equations is adjusted with a multiplier variable. There was expected that the self-reliance will be lower with an extremely high value and higher with the extremely low value compared to the base case.

The results from the tests are shown in figure 92. The results show the same behaviour as was expected. The influence of the social network of the minors on the self-reliance is very small since these children are mostly still living at their parents' home and receive the care and support they need. When implementing extremely low and high values for the change of self-reliance, this change should not all of a sudden be very significant. Therefore are these results the wanted results.

For the self-reliance of the adults with an IQ score between 50 and 70, the influence of the social network and being employed has a bigger influence on their self-reliance. Figure 92b, shows the expected results. However, the influence of the extremely low value is bigger than the extremely high value. A possible explanation for this is that the self-reliance of the population cannot become lower than zero and there will always be some people who are self-reliant. This is incorporated within the equation and probably be the reason for the difference in impact.



(a) (b)

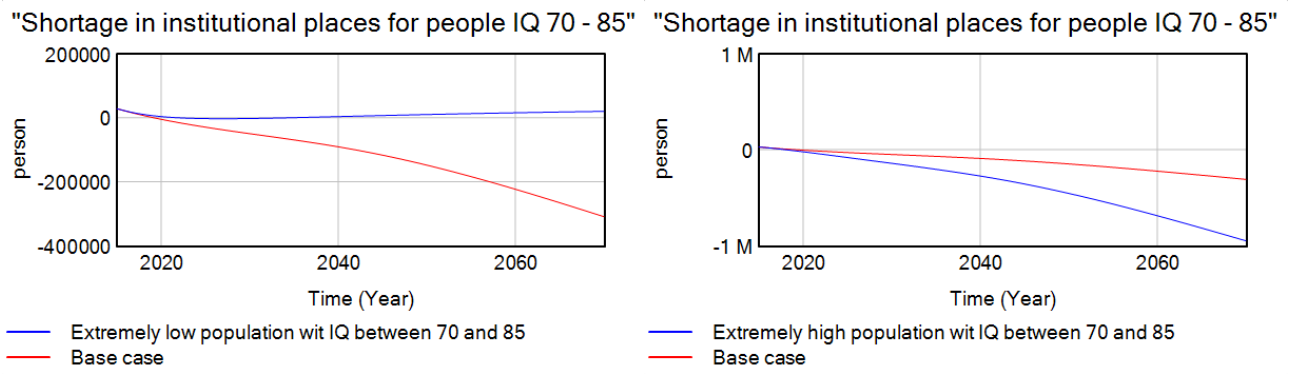
Figure 92: The self-reliance with an extremely (a) low or (b) high effect on self-reliance for the population with an IQ score between 50 and 70

Population IQ score 70 - 85 For the population with an IQ score between 70 and 85, the self-reliance has an even bigger impact compared to the population with an IQ score between 50 and 70. Therefore this KPI was also important to consider during the extreme conditions test. The shortage in insitutional places was also taken into account. In table 22, the parameters which were varied for the extreme conditions tests are shown.

Table 22: Overview parameters varied in the extreme conditions test IQ between 70 and 85

Input parameter	**Base case value**	**Extremely low value**	**Extremely high value**
Percentage IQ 70 - 85	0.136	0.00001	0.4
change self-reliance minors IQ 70 - 85	"Self-reliant minors IQ 70 - 85"*"effect on self-reliance minors IQ 70 - 85")/time delay	Base case * 0.1	Base case * 2
Change self-reliance adults IQ 70 - 85	"Self-reliant adults IQ 70 - 85"*"Total effect on self-reliance adults IQ 70 - 85")/time delay	Base case * 0.1	Base case * 2

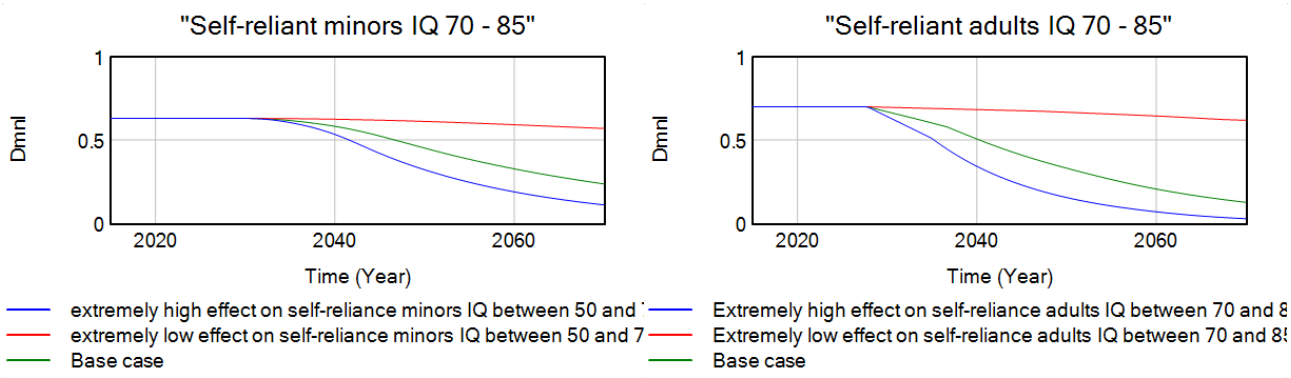
Just like was done with the other IQ groups, the population with an IQ score between 70 and 85 was set to almost zero and a extremely high value, in this case 40%. The same is expected, the shortage should be non existence for a extremely low population and even larger for an extremely high population. Figure 93, the results of the extreme conditions are shown. Just like with the two other IQ groups, the expected behaviour is visible within the graphs.



(a) (b)

Figure 93: The shortage of institutional places with an extremely (a) low or (b) high population with an IQ score between 70 and 85

The self-reliance for the population with an IQ score between 70 and 85 show more or less the same behaviour for the minors as the adults. The adults have a slightly bigger impact than for the minors, which is a logical outcome since most minors still live at home. Just like wiith the hgih exteme value for the influence on self-reliance for the adults with an IQ between 50 and 70, the influence of the low extreme value is bigger than with the high exteme value



(a) (b)

Figure 94: The self-reliance with an extremely (a) low or (b) high effect on self-reliance for the population with an IQ score between 70 and 85

G.2.2 Sensitivity analysis

A sensitivity analysis is a structure behavioural test, designed to determine the model's behaviour with small changes in the uncertain parameters (Forrester & Senge, 1980; Pruyt, 2013). This will measure the sensitivity of the model and will indicate the plausibility of the model. The entire model will be tested, based on the increasing and decreasing of 10% for the uncertain parameters. According to (Pruyt, 2013), there are three types of model sensitivities, (1) numerical sensitivity, (2) behavioural sensitivity, and (3) policy sensitivity. Numerical sensitivity appears when changing assumptions results in a change of numerical value change in the results. Behavioural sensitivity exists when changing the assumptions changes the patterns of behaviour of the model. Lastly, policy sensitivity appears when changing the assumptions reverses the influence of a proposed policy. For the sensitivity analysis of this research, the numerical and behavioural sensitivity is essential to examine.

Three techniques for sensitivity analysis were used, the multivariate, univariate technique, and a combination of the two techniques. The multivariate technique will evaluate the simultaneous impact of the parameters on the KPIs. The univariate technique will look at the unique impact of the different parameters on the KPI. The multivariate sensitivity analysis will be done first, to get a clear overview of the sensitivity of the parameters. After that, there will be looked for individual sensitivity to explain to the overall sensitivity of the model. There will be looked at changes in the outcomes of the KPIs, changes in value outcomes and changes in the trends found in the graphs. If an important parameter for the structure of the model was found to be sensitive, then there should be searched for a more accurate value. Since the self-reliance sub-model incorporates two feedback loops, a combination of parameters during the sensitivity analysis could also give more insights into the model behaviour. Therefore, this will be performed as the final step of the sensitivity analysis. In table 23 the parameters that will be changed with ±10% compared to the base value are shown. It was decided to focus on the parameters which were not supported by data but were based on assumptions to be able to validate the made assumptions.

To be able to use the lookup variables in the sensitivity analysis and vary the values with ±10%, an additional variable was added to the model. This variables was a multiplier, which altered the value of the variable with the ±10% interval.

Table 23: Overview of parameters varied in the sensitivity analysis

Parameter	**Base case value**	**Minimum value**	**Maximum value**
IQ <50			
Percentage care-dependent people IQ < 50	0.95	0.855	1
Apply rate minors IQ <50	0.4	0.36	0.44
Apply rate adults IQ <50	0.95	0.855	1
Percentage living in institutions IQ <50	0.9	0.81	0.99
IQ 50 - 70			
effect on regular school group minors IQ 50 - 70	WITH LOOKUP("Self-reliant minors IQ 50 - 70",([(0,0)-(10,10)],(0,0),(0.2,0),(0.299,-0.005),(0.3,-0.02),(0.339,-0.02),(0.34,-0.005),(0.379,-0.005),(0.39,0),(0.46,0),(0.47,0.005), (0.57,0.005),(0.57,0),(1,0)))	Base case value * 0.9	Base case value * 1.1
Effect on social network minors IQ 50 - 70	WITH LOOKUP("Self-reliant minors IQ 50 - 70",([(0,0)-(10,10)],(0,0),(0.19,0),(0.2,-0.015),(0.23,-0.035),(0.269,-0.035),(0.27,-0.02),(0.319,-0.02),(0.32,-0.01),(0.359,-0.01),(0.36,0),(0.51,0),(0.52,0.03),(0.6,0.03),(0.61,0),(1,0)))	Base case value * 0.9	Base case value * 1.1

education effect on social network minors IQ 50 - 70	WITH LOOKUP("Minors going to regular school minors IQ 50 - 70", ([(0,0)-(10,10)],(0,0),(0.33,0),(0.34,-0.02),(0.35,-0.05), (0.399,-0.05),(0.4,-0.03),(0.45,-0.03),(0.451,0),(0.49,0),(0.59,0),(0.6,0.03),(0.7,0.03),(0.71,0),(1,0)))	Base case value * 0.9	Base case value * 1.1
effect on self-reliance minors IQ 50 - 70	WITH LOOKUP ("normalized social network minors IQ 50 - 70", ([(0,0)-(10,10)],(0,0),(0.25,-0.005),(0.5,-0.003),(0.75,-0.002),(1,0),(1.25,0.001), (1.5,0.002),(1.75,0.004),(2,0.004),(3,0),(10,0)))	Base case value * 0.9	Base case value * 1.1
effect on employment adults IQ 50 - 70	WITH LOOKUP ("normalized social network minors IQ 50 - 70", ([(0,0)-(10,10)],(0,0),(0.29,-0.01),(0.31,-0.01),(0.34,-0.005),(0.379,-0.005),(0.38,-0.003), (0.409,-0.003),(0.42,-0.002),(0.479,-0.002),(0.48,0), (0.53,0),(0.63,0), (0.64,0.002),(0.74,0.002),(0.75,0),(1,0)))	Base case value * 0.9	Base case value * 1.1
Effect on social network adults IQ 50 - 70	WITH LOOKUP("Self-reliant adults IQ 50 - 70" , ([(0,0)-(10,10)],(0,0),(0.35,0),(0.36,-0.0214286), (0.038,-0.0357143),(0.39,-0.0285714),(0.42,-0.0285714),(0.043,-0.0214286),(0.47,-0.0214286), (0.499,-0.1),(0.5,0),(0.53,0),(0.58,0), (0.59,-0.5), (0.69,-0.5),(0.7,0),(1,0)))	Base case value * 0.9	Base case value * 1.1
Effect employment on self-reliance adults IQ 50 - 70	WITH LOOKUP("Employed adults with IQ 50 - 70", ([(0,0)-(10,10)],(0,0),(0.49,0),(0.052,0),(0.549,-0.005),(0.55,-0.015),(0.06,-0.015),(0.065,-0.01), (0.068,-0.01),(0.069,-0.005),(0.074,-0.005), (0.075,0), (0.08,0),(0.1,0), (0.121,0.01),(0.18,0.01),(0.181,0),(0.5,0),(1,0))	Base case value * 0.9	Base case value * 1.1
effect social network adults IQ 50 - 70 on self-reliance	WITH LOOKUP("normalized social network adults IQ 50 - 70", ([(0,0)-(10,10)],(0,0),(0.25,-0.02),(0.5,-0.015),(0.75,-0.005),(1,0),(1.25,0.01),(1.5,0.02), (1.75,0.03),(2,0.03),(3,0),(10,0))	Base case value * 0.9	Base case value * 1.1
Automation rate	0.009	0.0081	0.0099
Apply rate minors IQ 50 - 70	0.25	0.225	0.275
Apply rate adults IQ 50 - 70	0.6	0.54	0.66
Percentage living in institutions IQ 50 – 70	0.6	0.54	0.66
IQ 70 - 85			
"effect on regular school group minors IQ 70 - 85"	WITH LOOKUP("Self-reliant minors IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.469,0),(0.47,-0.03),(0.519,-0.03),(0.52,-0.025),(0.549,-0.025),(0.55,-0.01), (0.599,-0.01),(0.6,0),(0.63,0),(0.68,0), (0.681,0.01), (0.78,0.01),(0.781,0),(1,0)))	Base case value * 0.9	Base case value * 1.1

"Effect on social network minors IQ 70 - 85"	WITH LOOKUP("Self-reliant minors IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.459,0),(0.46,-0.0375),(0.499,-0.0375),(0.5,-0.025),(0.549,-0.025),(0.55,-0.0125), (0.589,-0.0125),(0.59,0),(0.63,0),(0.65,0.025), (0.7,0.025),(0.71,0),(1,0)))	Base case value * 0.9	Base case value * 1.1
"education effect on social network minors IQ 70 - 85"	WITH LOOKUP("Minors going to regular school minors IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.3,0), (0.319,0),(0.32,-0.0375),(0.349,-0.0375),(0.4,-0.025),(0.439,-0.025),(0.44,0),(0.49,0),(0.59,0), (0.591,0.03125),(0.69,0.03125),(0.691,0),(1,0)))	Base case value * 0.9	Base case value * 1.1
"effect on self-reliance minors IQ 70 - 85"	WITH LOOKUP("normalized social network minors IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.25,-0.03),(0.5,-0.02),(0.75,-0.01),(1,0),(1.25,0.02),(1.5,0.03), (1.75,0.05),(2,0.05),(3,0),(10,0)))	Base case value * 0.9	Base case value * 1.1
"effect on employment adults IQ 70 - 85"	WITH LOOKUP("normalized social network minors IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.45,0),(0.5,-0.01),(0.52,-0.02),(0.559,-0.02),(0.56,-0.015),(0.619, -0.015),(0.61,-0.01),(0.659,-0.01),(0.66,0),(0.7,0), (0.8,0),(0.801,0.001),(0.9,0.001),(0.901,0),(1,0)))	Base case value * 0.9	Base case value * 1.1
"Effect on social network adults IQ 70 - 85"	WITH LOOKUP("Self-reliant adults IQ 70 - 85" , ([(0,0)-(10,10)],(0,0),(0.45,0),(0.49,0),(0.5,-0.025), (0.51,-0.045),(0.55,-0.045),(0.56,-0.035),(0.6,-0.035), (0.61,-0.025),(0.65,-0.025),(0.66,0),(0.7,0),(0.8,0), (0.801,0.05), (0.85,0.05),(0.851,0.075),(0.9,0.075), (0.901,0),(1,0)))	Base case value * 0.9	Base case value * 1.1
"Effect employment on self-reliance adults IQ 70 - 85"	WITH LOOKUP ("Employed adults with IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.09,0),(0.1,0),(0.139,-0.015),(0.14,-0.03),(0.16,-0.03),(0.17,-0.025),(0.209,-0.025),(0.21,-0.015),(0.249,-0.015),(0.25,0),(0.28,0), (0.33,0),(0.331,0.025),(0.4,0.025),(0.401,0),(1,0)))	Base case value * 0.9	Base case value * 1.1
"effect social network adults 70 – 85 on self-reliance"	WITH LOOKUP("normalized social network adults IQ 70 - 85", ([(0,0)-(10,10)],(0,0),(0.25,-0.015),(0.5,-0.01),(0.75,-0.005),(1,0),(1.25,0.01), (1.5,0.02), (1.75,0.03),(2,0.03),(3,0),(10,0)))	Base case value * 0.9	Base case value * 1.1
Apply rate minors IQ 70 - 85	0.05	0.045	0.055
Apply rate adults IQ 70 - 85	0.3	0.27	0.33
Rejection rate IQ 70 - 85	0.4	0.36	0.44
Percentage living in institutions IQ 70 - 85	0.3	0.27	0.33

Multivariate sensitivity analysis The multivariate sensitivity analysis will determine the sensitivity of the combined changed values of the parameters of table 23 on the KPIs. The multivariate sensitivity analysis was performed using the

sensitivity tool in Vensim. All the parameters will be added with the ±10% and Latin Hypercube Sampling was used as a method to ensure equal sampling within the uncertainty ranges for each of the parameters. It was chosen to run 100 different values of each constant, which means in total 2900 separate tests. This is done in order to enable the comparison of the results. The most interesting and/or surprising results will be discussed.

Overall, there can be concluded that the shortage KPI is only a little numerical sensitive and therefore will not be considered in this chapter. Self-reliance, on the other hand, shows some behavioural sensitivity for the 70-85 IQ population, as can be seen in figure 95a and figure 95b. For the population with an IQ score between 50 and 70, shown in figure 95c, can be seen that this is also more numerical sensitivity. This numerical sensitivity mostly influences how much time the self-reliance of this population decreases.

The difference between the two KPIs in sensitivity can possibly be explained by the assumptions. For the shortage of institutional places for the intellectual disability populations, the assumptions could be mostly done based on factual data. While the assumptions for self-reliance were based on literature and assumptions of other research and own interpretations. Therefore these assumptions were more difficult to make. This sensitivity to self-reliance is therefore a bit expected.

The difference between the IQ groups can possibly be explained by the difference in care needs. As mentioned earlier, the population with an IQ score between 70 and 85 is in most cases able to live a relatively normal life. While the population with an IQ score between 50 and 70 will need fundamentally some care and support. Therefore the influence of more or less self-reliance will have a greater impact on the population with an IQ score between 70 and 85. Next to that, for this IQ group, there will probably be more factors to consider when determining self-reliance. Together, this could explain the difference in sensitivity between the two IQ groups.

During the univariate sensitivity analysis, there will be looked more closely at the influence of the separate parameters on the self-reliance for the different IQ groups.

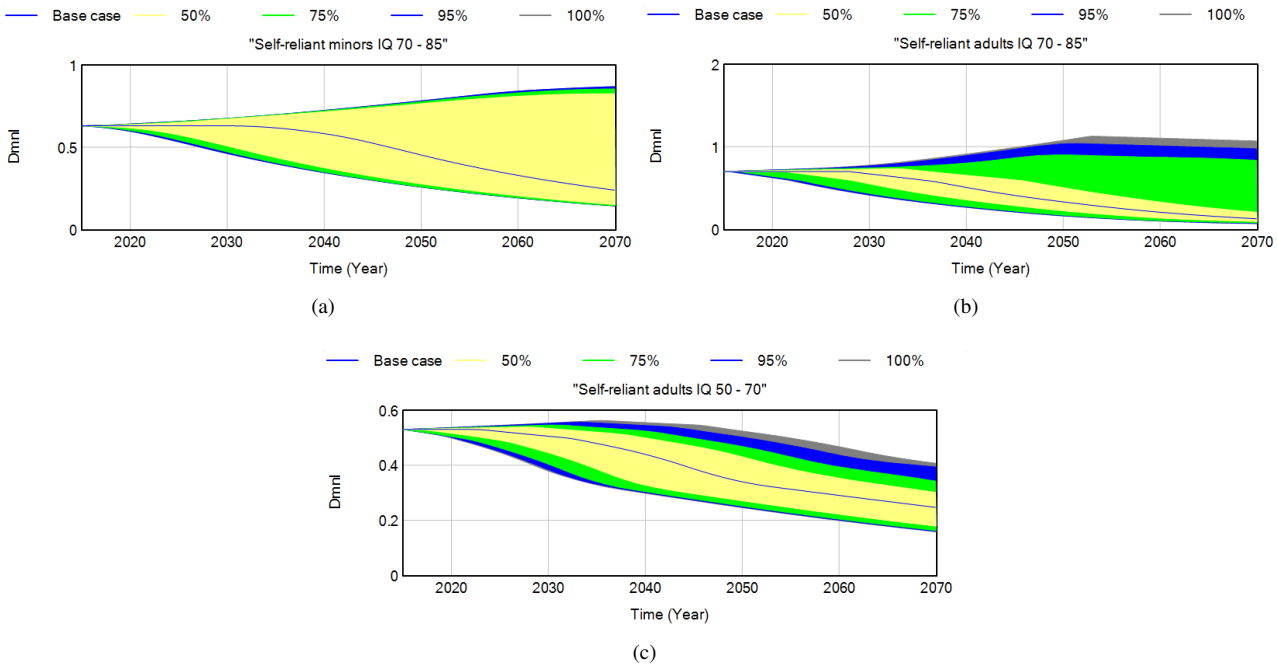


Figure 95: Results multivariate sensitivity analysis of KPIs - (a) self-reliance minors IQ 70 - 85, (b) self-reliance adults IQ 70 - 85, and (c) self-reliance adults IQ 50 - 70

Univariate sensitivity analysis The univariate sensitivity analysis was performed to examine the influence of individual parameters on the KPIs for self-reliance. As mentioned in paragraph G.2.2, the KPI shortage in institutional places for the different IQ groups is not found sensitive in the multivariate sensitivity analysis, so the focus for the univariate sensitivity analysis was on the KPI self-reliance. For this reason, not all the parameters, named in table 23 were used during the univariate sensitivity analysis. The parameters which influence self-reliance are the variables that have a lookup function

as the equation. The sensitivity of these variables on self-reliance was evaluated. Just like the multivariate sensitivity analysis, these values were altered with ±10%. The sensitivity tool in Vensim was used to perform the univariate sensitivity analysis. Within the analysis, a random uniform distribution was used, with 200 runs per parameter. The influence of these parameters on the KPIs which gave the most interesting or surprising results were evaluated.

An interesting outcome of the univariate sensitivity analysis is that the sensitivity of self-reliance is the influence of self-reliance on the ability to attend a regular school for minors with an IQ score between 70 and 85. In figure 96 the results of this univariate sensitivity analysis. After 2040, there is 5% of the random values which increase self-reliance. To examine the reason for this outcome, the univariate sensitivity analysis for this variable was done again, only than with an sensitivity interval of ±15% and ±20% and by increasing the number of simulations. These results are shown in figure 96c, figure 96d, and figure 96b. There can be seen that when the sensitivity interval is expanded, more runs will get the increased value and that when the number of simulations is increased there is not a real difference.

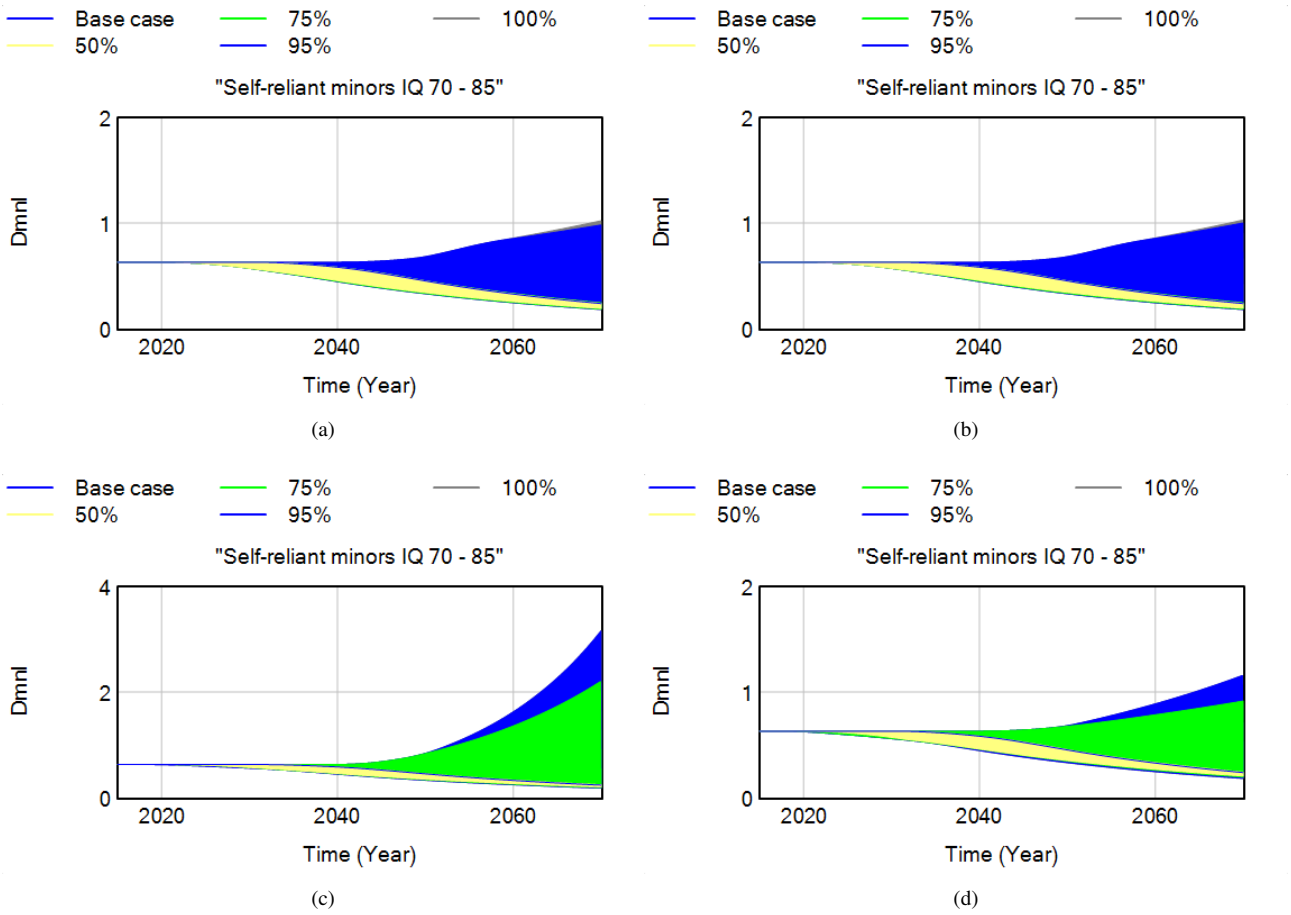


Figure 96: Results univariate sensitivity analysis of parameter effect on regular school group minors IQ 70 - 85- (a) ±10%, (b) ±15%, (c) ±20%, and (d) 500 simulations

While the adult population with an IQ score between 70 and 85 showed behavioural sensitivity during the multivariate sensitivity analysis, there was only some numerical sensitivity in the univariate sensitivity analysis. The numerical sensitivity was only visible in when the self-reliance of the adults would decrease.

Combined univariate sensitivity analysis The multi-univariate sensitivity analysis was done to explore the combined influence of parameters on the self-reliance of the different sub-groups. Within this multi-univariate sensitivity analysis, the same KPIs were found sensitive. The interesting outcome for the self-reliant minors with an IQ score between 70 and 85 when the effect on regular school was put in with the sensitivity interval, was also seen when this variable was combined with the influence on the social network. The outcome of this sensitivity analysis can be seen in figure 97. All the other combined parameters still had a numerical sensitivity, only the interval of the sensitivity was bigger.

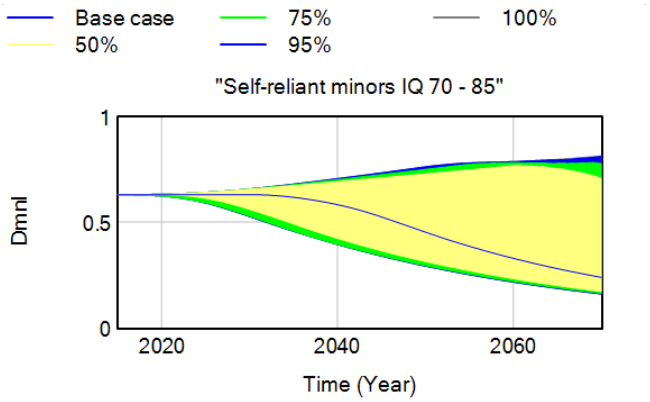


Figure 97: Sensitivity results of effect self-reliance on regular school and social network minors with an IQ score between 70 and 85