The Innovation of Population Forecasting Methodology in the Inter-war Period: The Case of the Netherlands

4.1 Introduction

The foundations of the model of population dynamics that was to dominate population forecasting methodology throughout the greater part of the 20th century were laid by the English economist Edwin Cannan (1861-1935). By the end of the 1930s, it had become the new standard model for forecasting national populations. After the Second World War, the model became known as the Cohort-Component Projection Model (CCPM).**[i]**

However, this does not mean that the introduction and general acceptation of the new methodology was a matter of *veni, vidi, vici*. On the contrary, almost three decades passed between its emergence in 1895 and its reinvention and general application for national population forecasting purposes in the mid-1920s.

Dutch innovators of population forecasting methodology were among the front-runners in the reinvention of the CCPM approach in the inter-war period. This contribution focuses on the nature of their contribution from an international perspective. First, we discuss the contributions of two international pioneers of CCPM forecasting, Edwin Cannan (1895) and Harald Westergaard (1908). Next, the focus is on the almost simultaneous re-emergence of forecast of national populations along CCPM lines. Was the general acceptance of the new approach to population forecasting a question of reinvention? If not, to what extent did the innovators of the 1920s build on the foundations laid by Cannan and Westergaard? This question is discussed in depth by focusing on the process of innovating population forecasting methodology in one particular country, viz. the Netherlands. The innovative nature of the respective contributions of the Dutch pioneers is assessed by means of, for example, a discussion of the forecasting culture in which they worked. Finally, the focus shifts to a discussion of how CCPM methodology was made suitable for urban forecasting and planning in the Netherlands in the course of the 1930s.

4.2 The pioneers of CCPM forecasting

Cannan was the first to introduce a cohort and age structure approach, relating past and future numbers of births to the (changing) age structure and the size of the fertile cohort groups in it. Cannan visualized his new approach with an appealing and much talked about age-period-cohort diagram (Cannan, 1895). The central element of CCPM is the cohort survival approach, which stems from the life-table, which already in 1895 was an elaborated instrument of demographic analysis.

At the time of its emergence, the dominant calculation model in the study of future population size was the geometric approach based on a constant rate of total population growth. Cannan's cohort approach is based on a comparative state analysis of successive population censuses (ten-year age groups by ten-year intervals) and the extrapolation of a time series of 'survival in England and Wales' proportions calculated by relating the observed number of persons in ten-year cohort groups in successive population censuses. These 'survival in England and Wales' proportions are not actually pure cohort survival rates but combined cohort survival and emigration surplus proportions of 10-year age groups in 10-year intervals. With respect to fertility, Cannan started from the assumption that the future number of births would remain constant in the years to come. The plausibility of this assumption was based on the expected future numbers of women in the fertile age period.

In terms of a good understanding of the future consequences of past and present population dynamics, Cannan's contribution was far-reaching: the plausibility of a future cessation of population growth rested on quantitative demographic-analytic argument. By means of the age (cohort) factor, Cannan was able to predict that a cessation of population growth and, eventually, even a decline was at hand; this would not occur as a result of war, epidemic or starvation, as many post-Malthusians believed, but occur in a non-violent way, viz. through demographic evolution. Cannan's paper was part of a growing awareness and concern, and it appeared just before the flood of neo-Malthusian and eugenicist publications (including those by Galton and Pearson) on the subject of the consequences of the declining rates of population growth and of social-class-specific birth rates

(Kreager, in this volume, chapter 5).**[ii]**

Twelve years later (i.e. in 1907), the Danish statistician and political economist Harald Westergaard astonished an audience of fellow members of the International Statistical Institute (ISI) when, during his opening address at the Copenhagen Session, he presented a practical application of CCPM-like theory in his ‘horoscope of the population in the 20th century’ (Westergaard, 1908). He demonstrated a masterly application of his knowledge of the effects of the interaction of population structure and change factors in population dynamics and a good understanding of the future direction of the pattern of fertility decrease.

Starting from the assumption of differences in pace of fertility decrease between European nations, Westergaard pictured in a purely qualitative way the consequences of demographic transition the countries of Europe were going to experience, in terms of both the ageing of the active population and the composition of the migration flows from Europe to the United States.

Westergaard’s demographic future was presented as a speculation (as is clear from the use of the word ‘horoscope’). His qualitative future can best be seen as a scenario of future demographic development. It is not surprising that he stressed its speculative character, considering he presented his paper to an international forum of pre-eminent statisticians and directors of national and municipal statistical offices. At the time, official statisticians in many countries held the opinion that statistical offices should stick to the facts, and not busy themselves with such speculative activities as forecasts (De Gans, 1999).

The prophetic quality of Westergaard’s endeavour is striking. His scenario was based on an intelligent and creative analysis of vital statistical data for Denmark, sound analytic-demographic reasoning and a thorough knowledge of the theory of life-table populations, and he demonstrated a clear insight into the dynamics of population change, caused by the interaction of population structure and the components of population growth.

Westergaard started with an overview of mortality and fertility trends. From an analysis of Danish statistical data on the fertility of marriages with duration of 10-15 years, he concluded that the practice of birth limitation had already gained momentum and would continue at a rapid pace. According to Westergaard, contemporary statisticians agreed that the decrease in mortality rates was structural and could not be interpreted as a momentary perturbation finding expression in a typical life-table. The immediate result of mortality decrease had been a growth of population in all Western nations such as had not been dreamed of in former centuries. Mortality decrease had led to a population explosion in the Anglo-Saxon world in the second half of the 19th century and consequently to a considerable change in the 'balance sheet of nations', because of pace differences between countries.

The decrease in mortality was followed by a decrease in fertility that started at the end of the 19th century. A reduction in the birth rate was occurring everywhere. Marked differences were caused mainly by differences of temporality: some countries had retained high birth rates somewhat longer than other countries had, France being the only exception. In France, a remarkable decrease had started around the end of the 18th century and had resulted in almost stationary population growth by the end of the 19th century because the increase in life expectancy had not kept pace with the decrease in fertility.

At the end of the 19th century, net fertility had been highest in the upper classes of society in spite of a lower birth rate than in the working classes, because the upper classes had a lower infant mortality. But this was changing rapidly.

At the beginning of the 20th century, differences in infant mortality (e.g. in Denmark) no longer compensated for differences in fertility between the social classes. From his own analysis of Danish statistics, Westergaard had established that a fertility decrease was occurring in all social classes. He assumed that a similar development would take place in all European countries.

Westergaard predicted future shifts in the balance of nations from the differences observed in the pace of the transition of mortality and fertility rates: '*Just as the Anglo-Saxon race increased in numbers during the nineteenth century, so we may* *in the future observe a quick increase of the Russians and Poles until also this movement comes to an end*' (Westergaard, 1908, p. 110). These shifts would cause significant new changes in the balance of nations, and particularly America would bear the consequences. In the past, America had been able to assimilate an influx of millions of mainly English-speaking immigrants who had proceeded to build a new English-speaking nation. Assimilation in the future would be more difficult if immigration were to alter its character, with the majority of newcomers coming from, for example, Russia or Italy.

Westergaard cautioned against the views of those who consoled themselves with the expectation that the end of the transition process would see a return to old times: '… *we shall not have the age distributions of former days, population will have an entirely different appearance, with its big numbers of old people and its relatively small numbers of young persons*' (Westergaard, 1908, 114).

The change of the age structure would have enormous effects. The burden of bringing up a child would be lessened, because more adults per child would be available to carry this burden. On the other hand, everywhere in the active population, '… *in offices and shops, the number of apprentices and juvenile clerks and assistants will be on the decrease, whereas grey-haired officials will be more abundant. And if it is true that all new ideas are born in young brains, then this difference of age distribution is identical with a serious loss for the future population*' (Westergaard, 1908, 113).

Westergaard's 'horoscope' of the population provides, in a comprehensive and highly evocative way, the earliest picture of the demographic transition of Europe in the 20th century.**[iii]**

4.3 CCPM forecasting in the 1920s: continuity or reinvention?

The effect of Cannan's and of Westergaard's endeavours was not such that current forecasting practice was immediately replaced. On the contrary, forecasting along the traditional line of future extrapolations based on the arithmetical or geometrical growth of total population size continued to be the standard practice for quite a long time. It is interesting to note, for instance, that they are not mentioned in Walter F. Willcox's overview of the best method of estimating the population of the United States, which was published in 1925. This is rather surprising, for Willcox must have had ample knowledge of contemporary population forecasting methodology: he had been chairman of a committee that had recommended the method of arithmetical progression for the United States

Census Bureau’s population estimates in 1906, and in 1925 he chaired a committee that had been asked to review the issue of the best way of forecasting the population of the United States (Willcox, 1925, p. 27, f.n. 1). Willcox does not refer to the new methodological developments triggered by Edwin Cannan, or to the logistic growth approach that had been introduced in the United States by Raymond Pearl in 1920, methods that were heavely debated in the first part of the 1920s (De Gans, 2002).

Willcox distinguished three different methods. The first was based on the assumption of arithmetical growth of the total population, and the second on the assumption of geometrical population increase (also termed the natural growth of the population). The third was a component approach, based on the measure of the balance of births and deaths and of immigration and emigration. The use of the geometrical growth model, furnished to the United States by England, was declined.**[iv]**

In the words of Willcox: ‘*No theoretical defense of the method of geometrical increase is convincing. That method, like any other, must be defended and justified not on grounds of theory but because its results agree with the enumerations more closely than do the results of any alternative method*‘ (Willcox, 1925, p. 28).

Compared to what, for instance, the German town planner R. Baumeister had taught his students as early as 1876, there was no innovative element in the overview drawn up by Willcox and his committee (Baumeister, 1876; De Gans, 2002).

Either Willcox had no information on developments outside the USA or he saw the new approaches to population forecasting as being of no use to the United States. Whatever the reason, it is remarkable that the new forecasting method was not discussed by his committee, because population forecasting along CCPM-like lines had made a fresh start since the First World War. About twenty years after Cannan’s forecast, CCPM-like forecasting was performed in many different countries almost simultaneously. In 1925 – the year of Willcox’s overview – several forecasts had already been made and many more were to come: in Austria (Wilhelm Winkler, 1919), the Soviet Union (Strumilin, 1922), England (Bowley, 1924), the Netherlands (Oly, 1924; Wiebols, 1925; ‘t Hooft, 1926/1927), Sweden (Cramér, 1925), the USA (Lotka, 1925; Whelpton, 1928), Norway (Jahn, 1926), Sweden (Wicksel, 1926), Italy (Gini, 1926), Germany (Statistisches Reichsamt, 1926; 1928), Italy (Vinci, 1927) and France (Alfred Sauvy, 1928).**[v]**

It has not yet been fully researched to what extent the above-mentioned forecasts should be seen as independent reinventions or as elaborations inspired by Cannan, nor whether – and if so, to what extent – the population forecasters of the 1920s influenced each other in modelling population dynamics.

In Bowley's case, the source of inspiration is clear: there is a direct line from Cannan's forecast of 1895 to Bowley's of 1924. As a student at the London School of Economy and Political Science, Bowley had been inspired by the forecast made by Edwin Cannan, who was teaching there. Later, Cannan and Bowley had become colleagues at the same institution. In his own lectures, Bowley made frequent use of Cannan's diagram (Bowley, 1935). However, Bowley improved Cannan's model in one significant aspect: instead of working with synthetic rates of survival in England and Wales, derived from comparative numbers of persons present in ten-year age groups of successive population censuses, as Cannan did, Bowley introduced rates of survival of five-year age groups derived from the life-table.

At the other end of the spectrum there is the Austrian statistician Wilhelm Winkler (1884-1984), who in 1933 claimed to have been the first (in 1919) to make a forecast of the future population size and age structure based on the age structure at a specific point in time and on assumptions with respect to the elements of population change (births, deaths, migrants) in an attempt to clarify the future effects of the casualties of the Great War (Pinwinkler, 2003, 100).**[vi]**

The extent to which Winkler really worked along CCPM lines remains unclear: we have no description of the precise calculation model he employed, merely a general methodological description. This goes as follows. The quantitative losses caused by the Great War are fourfold:

(1) losses of ablebodied men caused by actions of war (wounding; illness);

(2) losses among the general population caused by an increased level of mortality during the war;

(3) loss of births during the war caused by the absence of men;

(4) loss of births after the war caused by the deaths of men in the fertile age groups.

Winkler had taken as an example the future number of births and the future development of the total population of France from 1910 and 1918 (by five-year age groups and five-year intervals of time on the assumption of constant numbers of births, deaths and migrants) (Winkler, 1919, 60-64).

The focus in the following sections is on the innovation of population forecasting along CCPM-like lines by forecasters in one specific country, the Netherlands. The issues examined are what they contributed, how innovative their contributions were from an international perspective, and whether they influenced or were inspired by others, and if so, who these others were.

4.4 Dutch contributions to the innovation of CCPM forecasting
In the Netherlands, component forecasting and cohort component forecasting gained a solid foothold soon after their first appearance after the First World War. Internationally a method debate was going on between the proponents of the demographic CCPM forecasting method (Bowley, Fisher) and the proponents of the logistic method (Pearl, Yule).**[vii]**
At the same time, a method debate was raging also in the Netherlands, but here it was between proponents of two different demographic approaches, the 'Wiebols method' and the ''t Hooft method', which have in common the cohort survival element. The debate contributed greatly to the spread of knowledge of forecasting methodology among those who were interested in the future population size in general and the best way to calculate this in particular (De Gans, 1999).

The context of the Wiebols-'t Hooft controversy was a debate on the population issue in the Netherlands. The debate started in 1922 and continued throughout the 1920s and 1930s. Initially, the issue was the consequences of a continuation of the continuing high rate of population growth in the Netherlands since the First World War under grim economic conditions and prospects. Basically the population debate was between the advocates and the opponents of neo-Malthusianism, each side being represented by one of the leaders of the Dutch statistical establishment of that period: the pro-natalist H.W. Methorst (1868-1955) – who was the head of both the Central Statistical Bureau of the Netherlands (now Netherlands Statistics) and the Statistical Office of the International Statistical Institute (ISI) in the Hague – and the neo-Malthusian C.A. Verrijn Stuart (1865-1948), who had been Methorst's predecessor in both the offices mentioned.

Methorst argued that there was no urgent need for neo-Malthusianism because in due time the rate of population growth would slow down. His argument cwas founded on, among other things, a diagram in which the time series of the observed crude birth and death rates were graphically extrapolated.**[viii]**

Ultimately, so Methorst reasoned, the ongoing decrease in the birth rate which could be observed in the Netherlands too, would result in the ageing of the population and, therefore, in an increase in the death rate and, consequently, in the decrease in the growth rate of the population. Verrijn Stuart followed a different line of reasoning. In his view it was necessary to actively reduce fertility, because if the growth continued to be as high as it had been in the past years, future population growth would end in disaster. He illustrated his argument by using an extrapolation of the future of the population of the Netherlands based on a long-term geometrical progression calculation.**[ix]**
Because of the pro and anti neo-Malthusianism controversy, argument in the population debate was often based on emotion rather than on sound, objective reasoning. Many felt the need for a better understanding of population dynamics and of the demographic processes that were going on. This led A.O. Holwerda (1887-1944) – an actuary and one of the few representatives of the English school of mathematical statistics in the Netherlands at that time – to state that the statistician should be counselled on the relevant questions at stake. Methorst, so Holwerda said at the Annual Meeting of the Dutch Society of Political Science and Statistics in 1922 (during which the Dutch population issue was put on the agenda for the first time), had shown what was possible if statistical data were used in a correct and useful way. The population issue could not be discussed without an objective study based on adequate statistics, namely age and sex specific sets of what would be called now occurrence/exposure rates of mortality, legitimate and illegitimate fertility, nuptiality, and so on. First, these sets of transition rates had to be constructed. Next the development over time of each of these sets should be studied in order to gain a good understanding of the future course of population growth (VSS, 1922).

The debate at the Annual Meeting on the future size of the population of the Netherlands and its consequences led another actuary, Joh. C. Oly (1924), to bring his life-table expertise into play. In international historical overviews of population forecasting literature, Bowley’s 1924 forecast is often seen as the true beginning of modern forecasting. Oly’s forecast, which was published in the same year, is not mentioned in international overviews, nor are any of the innovative Dutch achievements in population forecasting during the inter-war period. But, as we shall see below, Oly's approach can easily stand comparison with that of Bowley.

Both Bowley and Oly started from life-table population theory and from life-table probabilities of survival. This was an innovation in comparison with Cannan's forecast of 1895, as was the distinction between the male and the female population.

With respect to fertility, both Bowley and Oly used constant future numbers of births and constant survival rates. That, however, is where the similarity between the two approaches ends. Because of the fear of the consequences of overpopulation that was at the heart of the Dutch population debate, he also calculated another, minimum variant. This variant was as realistic as possible given the current state of the art. He used dynamic (i.e. decreasing) birth rates (a decrease from 26 to 18 pro mil in 40 years) (Oly, 1924). By making two calculations based on two different sets of assumptions with respect to fertility, Oly tried to gain an insight into the range of the future population size. In doing so, he was the first in the Netherlands to calculate alternative demographic futures.

The unsound reasoning of many participants in the neo-Malthusian population debate (neo-Malthusians vs. anti-Malthusians), as exposed in quite a few of the publications on the subject, induced a complete outsider to join the debate: F.W. 't Hooft (1896-1941), who was an engineer rather than a statistician or an economist. This man had all the strengths and weaknesses of the intelligent, self-educated person in the field, combining originality with a stubborn adherence to a convincing but inaccurate model of population dynamics (his 'conveyor belt' allegory). He developed the tunnel vision of an amateur and outsider debating with representatives from the field of experts and insiders with respect to the truth of his model of population dynamics in terms of his conveyor belt theory. This, however, led him and many others astray.**[x]**

The allegory goes as follows. The dynamics of population growth is a process similar to that occurring on a conveyor belt. Granules (births) are put on one end of the belt. Some of these granules disappear during their transport on the belt (deaths at a young age) and some fall off at the end of the belt (deaths at the end of the 'natural lifespan'). He then substituted this model of population growth for another one: a conveyor belt with a length equal to that of the average lifespan of the deceased. Now the granules put on one end of the belt will fall off simultaneously at the other end. The size of the population in the substitute model is equal to the product of the number of births and the average age at the time of death (not to be confused with the average life expectancy at birth, or with the average age of the population).

If the length of the conveyor belt is increased – that is to say, if the average lifespan of the deceased increases – then the belt can accommodate more granules at the same time. The population therefore increases, but merely as a result of the temporary lengthening of the average lifespan. In time, however, the balance will be restored, after which the population size will be again the result of the product of the new average lifespan of the deceased and the (constant) number of births ('t Hooft, 1926).

't Hooft firmly believed that population growth would come to an end in the near future because the birth rate would follow the death rate. In this respect he was in line with the ideas of Jacques Bertillon and other French demographers, though it is not clear whether he was familiar with their writings. In 1903, Bertillon had formulated his 'well-known law of the parallelism of the movements of population'.**[xi]**

This law says that, in general, the levels of both natality and mortality are high in the same countries, and both are low in the same countries. In other words, if mortality is high in a certain country, its natality is high as well; and vice versa, if mortality is weak ('*faible*'), natality is weak too (Bertillon, 1903, p. 1). Because 't Hooft focussed so much on the lengthening of the average lifespan of the deceased as the main contributor to population growth, he tended to neglect the effect of fertility and that of the age structure of the female population. In fact, his theory held only under the condition of a strictly stationary population (in stable population theory).

As a consequence of his focus on the development of mortality, ‘t Hooft was the first to introduce (in 1927) the cohort approach into population forecasting based on generation life-tables; his approach was slightly more sophisticated than that of Cannan in 1895 (‘t Hooft, 1927). Above all, he did not refrain from provoking the community of Dutch population experts into a debate about the method of population forecasting during the greater part of the interwar period. In this way he contributed to the dissemination of knowledge of and insight into the analytical demographic backgrounds of population dynamics and demographic forecasting. He also forced the participants to reflect upon the respective merits of his approach and that of Wiebols.
‘t Hooft’s cohort approach was considered by many of his contemporaries to be of equal standing to that of Holwerda’s PhD student G.A.H. Wiebols (1895-1960). However, in the end Wiebols’ contribution to the development of population forecasting along CCPM lines in the Netherlands proved to be the most sustainable of the two: in the early 1930s, town planners working on the socioeconomic and demographic foundations of the 1935 General Extension Plan for Amsterdam demonstrated that the migration factor could easily be integrated into the Wiebols model.

Presumably, it was Holwerda who persuaded the economist Wiebols to write a PhD thesis on the subject of the future size of the population of the Netherlands, focussing in general on the methodological aspects of such a forecast, and in particular on the added value of working with *kanssystemen* (‘probability systems’, i.e. sets of age-sex-specific occurrence/exposure rates). Wiebols’ endeavour resulted in a clear and, from a methodological point of view, highly transparent demographic forecast, starting from age-sex structure (females only), dynamic (increasing) age-sex probabilities of survival derived from lifetables, and a dynamic (decreasing) general fertility rate. Much to his dissatisfaction, Wiebols had to make do with the general fertility rate instead of agespecific fertility rates because of the lack of sufficient statistical data. Wiebols was the first person in the Netherlands to build on the views of the Berlin statistician R. Böckh and those of Böckh’s former student Rahts regarding the population’s level of replacement (later called ‘net reproduction’) in order to convince the statistical offices (and the government of the Netherlands) of the need to work with age-specific fertility rates in population forecasting instead of general fertility rates, and thus incite them to collect the necessary statistical data regarding fertility (Wiebols, 1925, 38-42).**[xii]**

As was the case with almost all forecasts of European populations, Wiebols excluded international migration. He had good reasons to do so because of the societal setting of his calculations. Like Oly he was interested in the maximum size of the future population. Inter-war forecasters could not have foreseen that one day the Netherlands would have an immigration surplus. Neglecting international migration, therefore, meant neglecting an emigration surplus and therefore calculating a maximum future population. However, both in his book (Wiebols, 1925, 110-127) and in two letters to J.H. van Zanten, director of the Amsterdam Bureau of Statistics (Amsterdams Bureau van Statistiek) – who wanted to know what kind of statistical data his Bureau should collect in order to allow for the calculation of a population forecast for the municipality of Amsterdam – Wiebols presented a theoretical but highly sophisticated model of how to apply the new forecasting methodology at the municipal level, with the inclusion of migration and age-specific rates by marital state (De Gans, 1999, 25-28).

4.5 A culture of creative-practice-oriented, no-nonsense forecasting
It has not been possible to link, either directly or indirectly, the innovations in Dutch population forecasting methodology brought about by Oly, 't Hooft and Wiebols to the contributions of the international pioneers of CCPM forecasting methodology, viz. Cannan, Westergaard and Lotka. The main Dutch statisticians of the period – C.A. Verrijn Stuart and Methorst – were familiar with Westergaard's 'horoscope of the population of Europe'. Although Verrijn Stuart was clearly impressed by this 'extremely suggestive' picture of the future of Europe's population, initially he dismissed it because of its speculative nature (Verrijn Stuart, 1910, 286-287; De Gans, 1999, 79-80).

It is likely that the Dutch pioneers reinvented the new methodology independently of their international predecessors.13 Dutch actuaries like Oly and Holwerda were part of a long national tradition of life-table construction. Knowledge of life-table methodology was highly developed in the Netherlands. Moreover, if one looks at the methodological state of the art of population forecasting in the Netherlands prior to Oly and Wiebols, as represented in a few published

estimates and forecasts in the period immediately preceding the mid-1920s, one gets the impression of a culture wherein practical men were looking for practical solutions to everyday problems related to the future development of the population, the future number of households and the current and future housing need, and were using a lot of methodological ingenuity.
Some of these solutions resulted from problems faced by municipalities as a result of the 1901 Housing Act. This act can be seen as the formal beginning of urban and regional population forecasting and physical planning in the Netherlands. It established the close link between population forecasting, housing and town planning – that is, between the sciences of urban and regional planning and demography – that became characteristic of the Netherlands in the 1950s, 1960s and 1970s: under the Housing Act, municipalities with ten thousand inhabitants or more and municipalities which had seen a population growth of 20% or more in the past five years, were obliged to make urban extension plans.

The Housing Act became the legal basis of official housing policy. The municipalities were given the authority to improve housing conditions. They therefore needed a better insight into the kind and extent of housing demand and housing shortage and the development of housing need. This means that forecasts of future population, housing and extension plans were directly linked. This resulted in a growing interest among town planners in the development of good estimation methods. In the following decades, forecasting future population and future housing need became the core of preliminary town planning research – the precursor of modern urban planning.

Initially, the first decades of the 20th century saw a debate between proponents of different schools of town planning, namely the utilitarian school (mainly military and civil engineers) and the 'city beautiful' school (mainly architects). The former school had been responsible for town planning in the nineteenth century and was blamed for making the ugly town-extension plans that characterized the late 19th century urban housing districts. The debate had wound up at the beginning of the First World War in favour of the architects. From the point of view of the development of urban population forecasting methodology, this was a pity because while the architects were interested primarily in design, some of the town planning engineers – especially J.H.E. Rückert – were also interested in preliminary town planning research as a necessary condition for good urban planning.

Preliminary town planning research started to flourish in the Netherlands with the emergence of town planning as an independent profession in the First World War era. The new discipline was taught at Delft Technological University. The first generation of modern, university-trained town planners was influenced by the examples in German manuals of town building and town planning, dating from the last decades of the 19th century, particularly that of Baumeister (1876) and that of Stübben (1890). In these manuals it was advised to make traffic surveys, population forecasts (based on geometrical population growth methodology), studies of housing need and the need for recreation areas and industrial parks before embarking on the actual business of town planning.

In the mid-1920s, British rather German influences started to manifest themselves in the Netherlands through Patrick Geddes' doctrine of 'survey before plan'. These new influences reinforced the effect of the earlier German influences. It was the Amsterdam conference of the International Garden Cities and Town Planning Association in 1924 that familiarised the Dutch with the doctrine, propagated by Abercrombie and Unwin, and helped the idea of regional planning to mature among policy makers (Faludi & Van der Valk, 1994).

The first to put the new principles of preliminary town planning research into practice was the military engineer Rückert, director of Tilburg's Public Works department (Rückert, 1917). He drew his inspiration primarily from German town planners. In the following decade, his preliminary town planning research report on the General Extension Plan for Tilburg – which contains a thorough and well founded demographic analysis and extrapolation of future population growth (though with traditional methodology) – became exemplary, although it had found little support in the 1920s.

4.6 A promise of new developments: Rückert's forecast for Tilburg (1917)

That demographic forecasting in general and CCPM forecasting in particular were to become the new standard approaches in population forecasting methodology in the Netherlands in the inter-war period, could not have been

predicted from pre-war history. But the harbinger of the new development was already present in a number of cases of well founded geometrical population growth forecasts made at the end of the First World War.
If Rückert had merely acted in line with Baumeister and Stübben – his German sources of inspiration – he would have started from the premise that a general extension plan had to provide for a population twice the size of the present one. By dividing this number by the figure of the average density per hectare of the existing built-up area of Tilburg, the required plan area could easily have been calculated. Instead, Rückert preferred to use a different approach.

First, he started from a different average population density figure, which was in conformity with the current norm. Next, in order to check his results, he calculated the population size that would result from dividing the total number of running metres of frontage in the extension plan by the average frontage (in metres) per habitant in the existing built-up area, and saw that the resulting population size was close to that obtained by the first method. Finally, he used the geometrical population growth rate approach to calculate how long it would take for the size of Tilburg to double and for the planned town extension capacity to be attained.

The average annual growth rate of the future population was determined by analysing the observed population growth rates of the periods 1879-1909, 1899-1909 and 1909-1914. He checked the plausibility of the assumed future average annual growth rate of Tilburg by analysing the observed annual birth and death rates, the natural growth rates, the crude nuptiality rates and the absolute natural and total population growth of Tilburg in the last 'normal' (pre-war) period, viz. 1890-1914. From this analysis of the observed time series, he concluded that natural growth rather than an immigration surplus had brought about the population increase Tilburg had seen in the period under consideration. Basing himself on various factors (e.g. the construction of a new shipping canal and the alleviation of the housing shortage), he expected an improvement in the economic conditions of Tilburg and hence an increase in immigration. Because of their young average age, he expected the future migrants to have a positive effect on the birth rate and concluded that his figures should to be taken as a minimum forecast.

In his use of orthodox geometrical population growth theory, Rückert's actual population forecast is traditional. But it was demographic in the way he made assumptions. Like Baumeister (1876), Rückert did not believe in a law of geometrical population growth, although he had no choice but to use the geometrical growth method. He was convinced that the deduction of future developments from past ones does not provide a solid standard; the rates in the future may be very different from the ones calculated.

The novelty lies in the prudence of its application: time and again Rückert looked for feasible arguments and ways to check his calculations. He was inventive, and although not an innovator of forecasting methodology itself, he was exemplary in his search for a solid foundation for his assumptions within a wider socio-economic context.

4.7 Structural housing shortage? Rooy and the calculation of the future housing need (1920; 1921)

Another example of the promise of the new development in population forecasting is the forecasts of the national population made by Rooy in 1920, and again in 1921 (Rooy, 1920; 1921). His calculations are of particular interest because they concerned a key issue in post-First World War Dutch society: the housing shortage.

The housing shortage was seen as a serious problem, and it incited public concern. While the policy of the Minister of Labour, who was responsible for housing, was founded on the conviction that the housing shortage problem would soon be solved, critics, like Rooy, thought otherwise: they were of the opinion that the existing housing shortage had a structural dimension. Rooy provided them with quantitative arguments based on the analysis and forecast of the determining factors of the housing shortage. He warned against the dangers of underestimating future housing demand and blamed the government for not taking sufficient account of such factors as the negative effect of the eight-hour working day on housing production, and the effects of the increase in population and of the decrease in average household size on future housing demand.

The procedure Rooy employed was the following. First, he estimated the housing shortage in 1921. He did this by comparing the actual number of dwellings in 1920 and the calculated number on the basis of a linear extrapolation (from 1909 to 1920) of the decrease in the average dwelling occupation figure observed between the census of 1899 and that of 1909, with the population size in 1920. Next he had to take into account the backlog in the necessary replacement of obsolete houses since 1914 (the year the Great War began) and the necessary stock of uninhabited houses (estimated at 3% of the total housing stock). He found that seven years' of housing production had been lost as a result of the First World War (in which the Netherlands did not participate).

Once the housing shortage in the baseline year for his population forecast had been assessed, Rooy proceeded to forecast the increase in the housing demand resulting from future population growth.

The first thing he had to do was estimate the growth of the population in the coming decades. He assumed that a future decrease in the birth rate would be more than compensated for by a future decrease in the death rate. This would result, he expected, in a continuation of population growth in the following two decades at the level of the ten-year growth rate observed in the past decade. Having an estimate of the size of the population in the baseline year 1920 (from the census) and having assessed the ten-year growth rate of the population in the decades to come, he could calculate the future size of the population.

Next, he had to make assumptions about the proportion of persons not living in houses (which he kept constant at 3.3% of the total population), the decrease in the average dwelling occupation figure (which he assumed to decrease at 0.07% per decade) and the stock of uninhabited houses (which he set at 3% of the total housing stock). Moreover, obsolete houses had to be replaced, as had dwellings lost as a result of city formation.

Taking all these factors into account, he assessed the actual future housing demand. He came to the conclusion that on average about 55,000 houses would have to be built each year. With the means available at the time, a maximum of approximately 25,000 houses per year could be built. Rooy therefore came to the disconcerting conclusion that the required annual production would fall short by 30,000 houses and, therefore, that the housing shortage should be seen as a structural problem.**[xiv]**

Rooy calculated the future housing need in a simple, straightforward and pragmatic way. Basically, he merely used extrapolations of the average dwelling occupation figure and used the geometrical population growth method (with a growth rate of 16.6% per decade) to forecast future population size. The plausibility of this is sustained by demographic reasoning, deduced from observed and expected tendencies in the birth and death rates maintaining their balance.

The method is simple but efficient and satisfactory, given the task Rooy had set himself. The method is also a good example of a no-nonsense approach in applied ('everyday') population forecasting.**[xv]**

4.8 Rikkert and the 'Halle method' (1919) – or the shortcomings of extrapolating average dwelling occupation figures

Rooy did not refer to the fact that, a year earlier, an Amsterdam housing expert had severely criticised the use of extrapolated average dwelling occupation figures for forecasting purposes. The expert – Rikkert – based his criticism on the 'Halle method', which is the third example of intelligent applied forecasting to be discussed here.

The method was originally developed in the German town of Halle-am-Saale. It was applied for the first time in December 1905 and the results appeared in a publication by the Statistical Office of Halle, *Die Leerwohnun-gen in Halle a.S., 1905-1911* (Heft 17, 1912. Halle: Gebauer-Schwetsche). It was introduced in Amsterdam in 1914 by the civil engineer J.C.W. Tellegen, who was director of the Department of Building and Housing Supervision. From the moment of its introduction, the Halle method was successfully applied in Amsterdam in the inter-war years and also became popular in other municipalities.

The merits and demerits of the method were amply discussed by housing experts in the inter-war years and again in the 1970s (De Gans, 1999, 162-168).

The method was developed for the accurate estimation of the annual changes in the number of households (families) in a municipality. Once the number of households was known, the number of households in need of a dwelling could be estimated and, by making a comparison with the municipal housing stock, so could the size of the current housing shortage.

By modern standards the Halle method was quite advanced: the process of family formation and dissolution was essentially modelled in terms of marital state transitions. The application of the method depends to a high degree on reliable, up-to-date statistics on marital state transitions. It is therefore interesting to see how the method was summarized by J.H. van Zanten, director of the Amsterdam Bureau of Statistics and a fervent advocate of the method.

According to Van Zanten, the statistical office in Halle investigated the conditions leading to the formation of new families (who would then need a new dwelling) and the disappearance of families (which would provide uninhabited dwellings). Generally speaking, immigration leads to the former and emigration and death to the latter, although not every wedding results in an increase in housing need, nor does death inevitably result in the vacating of a dwelling. The Bureau concluded that housing need increases with the marriage of unmarried people, the marriage between a divorced man and an unmarried woman, and the immigration of a family. Housing need decreases with the marriage of a widower and a widow, the marriage of a widower and a divorced woman, the death of a widower, widow or divorced woman, and the emigration of a family. Because the method was not one hundred percent accurate, checks and verifications against census data were necessary from time to time. Several factors lead to inaccuracies: not all marriages of unmarried persons increase the housing need, not all persons marrying a person from outside the municipality compete on the municipal housing market, and not all widowers/widows continue to occupy a dwelling after the death of their spouse. Moreover, cohabitation outside wedlock (concubinage, brothers and sisters, and unrelated persons living together) is a totally uncertain factor (Van Zanten, 1938, 356-358).

The Halle method allowed for an analysis of the process of family/household formation and dissolution on an annual basis and provided an insight into the true development of housing need. The method could also be applied retrospectively by calculating the development of the number of families/households needing a dwelling over the past period. With the Halle method, Rikkert – the housing statistician at Amsterdam's Department of Housing – was able to demonstrate that the housing shortage in Amsterdam had increased considerably in the period 1909-1918. This conclusion differed considerably from what could be assumed from the course of development of the average dwelling occupation figure over the same period.
The shortfall was an important discovery. Rikkert made it clear that the average dwelling occupation figure depended on changes in the demographic factors of

family formation and dissolution on the one hand, and changes in the housing stock on the other. Therefore the extrapolation of observed time series of the average dwelling occupation figure for forecasting purposes was based on unsound reasoning. Rikkert was the first to warn against the use of the average dwelling occupation figure as an independent instrument for the prediction of the future housing need (Rikkert, 1919; Van Fulpen, 1985).

The above examples provide an insight into the general forecasting culture, as it existed in the Netherlands at the time of the reinvention of CCPM methodology. It was a culture wherein men, who were interested in the issues at stake, applied a careful, creative and no-nonsense way of reasoning in order to develop methods for finding solutions to practical issues.

Because of the lack of references it is difficult to assess whether Rooy knew of the studies by Rückert and Rikkert. Rooy published his articles on calculating housing shortage and housing need in the monthly journal *Economisch-Statistische Berichten*, an authoritative journal in economics and statistics. Despite this, and rather surprisingly, there are no references to his population forecasts in the contributions of those who participated in the national debate about the population issue (Verrijn Stuart, Methorst, Oly, Wiebols, 't Hooft). It is hardly possible that these men were not familiar with Rooy's publications.

The only plausible explanation is that Rooy was tackling a different issue and that it was thought that Rooy's issue had nothing to do with the population issue they were discussing.

4.9 CCPM methodology made suitable for urban forecasting and planning

Wiebols applied for a job in the field of town planning, but in vein. It was not to be Wiebols who would apply the elaboration of his population forecasting schemes for urban forecasting purposes. Nor was it to be another economist, or a statistician or demographer. It was the members of a different profession who made CCPM forecasting suitable for all geographical levels (national, regional, urban) by integrating migration into the calculation schemes of the forecasting model.

In the elaborated and well founded 1932 population forecast for Amsterdam, which was made for the 1935 General Extension Plan for Amsterdam, the town planners and forecasters Van Lohuizen and Delfgaauw demonstrated that Wiebols' approach could easily be applied to migration (Grondslagen, 1932). Also, they were the first to calculate age-specific headship rates (calculated from census data) and to apply these rates to the forecast age structure of the population, using the Halle method to check and correct these rates. This allowed a better insight to be gained into future housing than did working with average family size rates or average dwelling occupation figures, the use of which continued to be popular.

In his forecast for Rotterdam and the Rotterdam harbour area, the town planner Angenot (1934) combined the best of Wiebols' methods – now using age-specific fertility rates for the first time in the Netherlands – and the best of 't Hooft's (his generation life-table approach). Angenot was well aware that migration has a two-way impact on population development: firstly through mere numbers, and secondly because its age-specific character affects the fertile age categories and thus the number of births. He opted for a formal modelling approach, searching for arguments to simplify his calculations. Moreover, he was the first to introduce a matrix notation and a matrix mathematics approach to his calculations, separately for mortality/fertility and migration. His model was well ahead of but definitely not as elegant as Leslie's matrix model of 1945.

The forecasts for Amsterdam and Rotterdam stand out because of their sophistication in terms of the further innovation of forecasting methodology. They, and many others, were explicitly made to serve town planning purposes. The forecast for Amsterdam, which was inspired by the socio-economic and demographic survey work in Rückert's 1917 General Extension Plan for Tilburg, was considered to be the main building block of the 1935 General Extension Plan for Amsterdam. They were fine examples of how seriously preliminary town planning research was taken.

The conflicting plans of neighbouring municipalities as well as a growing awareness of the need to protect the valuable cultural-historical and natural landscapes of the Netherlands in the 1930s had resulted in a call for regional and metropolitan planning. Here again Van Lohuizen and Delfgaauw took the lead. Given the lack of sufficient statistical data on inter-regional migration, they demonstrated how a population forecast for a specific region could be derived from the national population forecast.

Another new development was the influx of geographers, socio-economists and sociologists in the field of preliminary town planning research. With extension planning booming, town planners were more interested in the actual designing process than in the necessary preliminary demographic and socio-economic town planning research. That task was left to geographers and other social scientists looking for jobs outside the teaching profession.
Van Lohuizen, Delfgaauw, Angenot and others demonstrated how migration could technically be integrated into the calculation schemes of Wiebols' 'demographic method'. However, they did not solve the problem of making assumptions about the future development of migration. In fact, the migration assumption part of their forecasts was rather primitive. In the eyes of the new professionals in preliminary town planning research – that is, geographers and economists – the demographic method was only second best to the preferred socio-economic method. In their view, a future labour market approach would be the best way to solve the problem of the unpredictability of future migration. Because of the time- and money-consuming complexity of this approach, the socio-economic method of population forecasting was not applied in practice, at least not in the 1930s. I have discussed the issue of demographic versus socio-economic forecasting more amply in my book on the history of population forecasting (De Gans, 1999).

4.10 Concluding remarks

Demographic statisticians and housing experts/town planners/demographers engaged in the quantitative study of the future of the population seem to have lived in separate worlds in the period prior to the Second World War. Those involved in the neo-Malthusian population issue debate appear not to have looked beyond the studies directly devoted to the population issue. On the other hand, urban and regional planners were not engaged in the study of the future size of population because of a mere academic interest in the population problem. To them, the demands of town planning practice were the starting point. These men were looking for practical solutions to the problems they encountered, merely judging and testing the practical application value of the methods at their disposal. For instance, they took no part in the debate about the Wiebols-'t Hooft controversy in national population forecasting, but simply selected the best of each method.

Oly, Wiebols and 't Hooft published for a Dutch audience only. The Dutch demographic statisticians who knew of their work and who took part in international statistical and demographic organizations and conferences, Verrijn Stuart, Methorst and Van Zanten appear not to have been too interested in the international exchange of information on the methodological achievements in the field of 'speculations' about future population development in the Netherlands. On the contrary, Van Lohuizen, Delfgaauw and Angenot both had the opportunity and were eager to share information with colleagues from other countries. However, the exchange of information remained restricted to the international town planning forums. Information on innovative developments in demographic forecasting, applied in urban and regional planning in the 1930s, did not reach the international forums of statisticians and demographers.

In fact, the information hardly reached the international community of town planners either. Here, the fact that the propagators of preliminary town planning research had a minority position in the world of town planning was an impediment to the propagation of information about innovations at urban and regional levels. Most town planners were interested primarily in the design of the plans; their second concern was the way in which the plans were based on research (surveys). The specifics of the forecasting models underlying these foundations seem to have been the least of their concerns.

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NOTES

i. The main elements of CCPM, as it was developed in the 1920s and 1930s, are the agesex structure of the population at a specific point in time and extrapolated age-sex-specific rates of the components of population change: mortality, fertility, migration. The future size of population is calculated from the projected numbers of persons in each agesex group. Burch finds it in his contribution to this book (pp. 39-58) hard to understand why CCPM has remained so popular, notwithstanding its many strong points:

– It is a powerful and flexible abstract model of population dynamics
– It explains the past
– It results in contingent but confident prediction
– It provides a guide to future intervention
– Its mathematics is quite easy.
– The model can easily be grasped and used by geographers, planners and demographers.

ii. Cannan's approach was not completely new. For instance, as early as the mid-18th century the Dutch actuary Kersseboom had demonstrated – in the absence of integral population censuses – that the size of a population could be estimated from a suitable life-table and assumptions with respect to the future annual numbers of newborn babies (Kersseboom, 1738-1742). For a more elaborate discussion of Cannan's contribution to population forecasting, see De Gans (1994); also Kreager in this volume**.**

iii. Also in 1907 Alfred Lotka started using the terminology of formal demography to develop his stable population theory, clarifying the relation between age structure and the components of natural population growth and between stable and real populations (Lotka, 1907).

iv. The method of geometrical progression had been introduced by William Farr at the English Registrar General's Office after the introduction of a national system of registration, and was often referred to as 'the Registrar General's method' (Willcox, 1925: 28).

v. De Gans (1999, pp. 96-97). I am indebted to Prof. Rainer Mackensen, who drew my attention to Winkler's work (Winkler, 1919; 1933) and to Prof. Nico Keilman, University of Oslo, who informed me about the population forecast made by Gunnar Jahn (Norway) (1926). For a discussion of the forecasts the the Statistisches Reichsamt, see Fleischhacker (this volume, chapter 9).

vi. "Etwas grundsätzlich anders (..) sind Vorausberechnungen des Altersaufbaues und der Bevölkerungszahl in Fortführung eines gegebenen Altersaufbaues mit Hilfe irgendwelcher Annahmen über die weitere Entwicklung der Bevölkerungsbewegung, wie sie der Verfasser zur Verdeutlichung der späteren Wirkung der Kriegsverluste wohl als erster vorgenommen hat und wie sie heute in der Bevölkerungsstatistik der vom Geburtenrückgang bedrohten Staaten üblich ist.' (Winkler, 1933, 108; also Pinwinkler, 2003, 99-104.).

vii. For a discussion of the debate, see De Gans (2002); also Kreager (this volume, chapter 5).

viii. Both Methorst's approach and the diagram he used were very similar to those of a fellow member of the International Statistical Institute, Pontus E. A. Fahlbeck (Sweden) (Fahlbeck, 1905).

ix. At first sight it is surprising that both Methorst (1922) and Verrijn Stuart (1919; 1922) were involved in calculations of future population size. Their behaviour seems to contradict the position they took towards forecasting. In their view, statisticians and statistical offices should abstain from the actual business of forecasting because the speculative aspect of forecasting could endanger the faith in the reliability of the statistical data statisticians had to supply in the first place (De Gans, 1999). It should be noted, therefore, that Methorst saw his extrapolation as a private affair. Verrijn Stuart did not consider his future calculation to be a true forecast, but at best a self-denying forecast: he wanted to demonstrate that a continuation of the high growth rate would ultimately result in absurd situations. The societal impact of the extrapolations of Methorst (1922) and Verrijn Stuart (1919; 1922) can only be understood properly if the authoritative position of these men in the national field of statistics, economics and demography is taken into account.

x. The debate and the nature of his conceptual mistake are amply discussed in De Gans (1999).

xi. " … la loi bien connue de parallélisme des mouvements de population" (Bertillon, 1903: 1) We are not dealing here with the issue of the relative truth of this law. It is interesting, however, to read that Saltet & Falkenburg (1907, 3 & 5) who were critical with respect to the empirical foundations of the law, did not speak of 'law' but of the 'theory of the parallelists'.

xii. Alfred Lotka worked at integrating fertility into a general dynamic theory of population. Few had thought to distinguish 'marital' fertility from 'illegitimate' fertility. This started to change only in the mid-1940s (Rosental, 2003, 104).

xiii. For a discussion of the likelihood of an independent reinvention in the Netherlands, see De Gans (1999, 78-81).

xiv. I have avoided presenting most of the figures Rooy used for his calculations. For these, see De Gans (1999, 129)

xv. The word 'everyday' is an overstatement. However, presumably many more future calculations must have been made, and some of these must now be hidden away in the archives of departments and municipalities, waiting to be discovered. The number of published forecasts, however, is small.

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