Introduction

The exploitation of the Ombilin coal mines in Sawahlunto saw not only the construction of mines, but also enhanced railway lines and a harbour within an interconnected technological system. The execution of such a large scale project required a large work force, with workers originating from all parts of the Netherlands, the East Indies and even beyond the boundaries. As the pit coal mines were located in a barren area, an urban planning scheme had to be established. This project has since been recognized as unique and, as a result, the Ombilin Coal Mining Heritage of Sawahlunto has been nominated by the Government of the Republic of Indonesia as a UNESCO Cultural Heritage site. In support of the consideration of this project for the nomination, it is important to highlight its global impact. In this paper I will discuss the technology and processes involved in the dissemination of technology from West Sumatra to South Africa.

Delfts’ Civil Engineer J.L Cluysenaer (1843-1932). A linking pin?

Following the discovery of coal in Sawahlunto, West Sumatra in 1868, several engineers were commissioned by the Ministry of Colonies and the Indies Government to explore the possibilities of exploiting coal mines and building a railway for transportation. Amongst them was railway engineer, J.L. Cluysenaer. In order to advise the government, Cluysenaer conducted field research in West Sumatra and presented extensive designs for a railway track linking the coal mines with the harbour. The finalized design, which underwent a number of adaptations, was implemented by the government under the management of railway engineer, J.W. Ijzerman (1851-1932).

It was not self-evident that the government implemented this project during this period of liberalism. In his article, Colombijn describes the discussion in Dutch parliament regarding the execution of this project. Cluysenaer advised, in his first report, that the implementation

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be transferred to the Indies government for economic reasons. Parliament was in favour of outsourcing the project to private entrepreneurs. Several private companies applied for the concession but they all failed to meet the procurement conditions. The government finally accepted Cluysenaer’s advice and started implementing the project in 1887.

Once construction had started, the discussion in parliament shifted to whether the government or a private company should be responsible for exploitation.

In 1889 the Minister of Colonies approached Cluysenaer for advice regarding the exploitation problem and the most appropriate party to exploit the mines. Surprisingly, Cluysenaar turned out to be a proponent of private company. This change in perspective was, according to the Minister, motivated by self-interest. Several private entrepreneurs had applied for the concession, among them Cluysenaer and P.J. van Houten, a merchant from Padang. Parliament however decided that the government itself should be responsible for exploitation.2 It is remarkable though that Cluysenaer changed his mind regarding the issue and the question is why he did so.

Parallel to the developments in West Sumatra, Cluysenaer appeared to be involved in the realization of a railway line in Transvaal, South Africa. In 1887, together with R.W.J.C. van den Wall Bake, he founded the Nederlandsche Zuid Afrikaanse Spoorwegen (NZASM, Dutch South African Railways Society) and the two became the directors.3 Under their management, a project similar to that in South Sumatra was developed, namely a technological system consisting of a railway network, a mine and a harbour in combination with an urban planning project. Literature frequently refers to the fact that several of Cluysenaer’s former West Sumatra colleagues were involved in the construction of this railway network.4 There are some indications that the Ombilin project served as a model for the NZASM and that the knowledge acquired in the Ombilin Coal Mining Company disseminated from West Sumatra to South Africa. In terms of the Ombilin Coal Mining

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2 Idem: pp. 448-449
3 Cluijsenaer, Jacobus Leonardus (1843-1932) http://resources.huygens.knaw.nl/bwn1880-2000/lemmata/bwn2/cluijsenaar
Heritage of Sawahlunto this link may be of interest as it further illustrates the project’s global impact. However, until now this link has not been researched. This research paper is guided by the following research question: How was the technological knowledge built up in the project of the Ombilin Coal Mining Company in Sawahluntu used in South Africa?

A railway line in West-Sumatra: from the coal mine to the harbour.

Jacobus Leonardus Cluysenaar (Breda 11/5/1843 – The Hague 8/8/1932) graduated as a civil engineer from the Royal Academy of Delft in 1863. At the start of his career he was employed in the construction of the national railway lines, but after six years he left the ‘Waterstaatsdienst’ (Public Water Works) to become a teacher at the then recently established HBS in Breda. When the opportunity arose for him to undertake pioneering work in Sumatra, he eagerly accepted the challenge.5

In 1868 mining engineer W.H. de Greve discovered the presence of coalfields at the river Ombilin in West-Sumatra. Three years later he presented a design for the mining of the coal mine and a railway line to the port of Padang, including cost calculations. Unfortunately, when he explored the possibilities for exploitation for the second time in 1872, he drowned in the Indragiri River.6 In 1873 Cluysenaer was appointed to head a commission tasked with conducting a survey for a railway line from the coal mines to the harbour.7

In order to perform the research he put together a team to carry out the fieldwork, consisting of engineers W. Verwey Azn., A.N.J. van Hees, R.A.I. Snethlage, J.W. IJzerman and J. Havelaar, and superintendents W.L. Dijkman, H.L.C.H. Sarolea, J.P.J.H. Alsdorf, K. de Vidal de St. Germain, J.Bouwens, H.G. Dijkerman and J. Brandt.8 The Governor General allowed Cluysenaer to use his own discretion in carrying out this research.9 Inspired by, in his own

7 J.L. Cluysenaer, Overzicht van den stand der werkzaamheden aan het einde van de tweede helft van het jaar 1873 opgemaakt en den Direkteur der Burgerlijke Openbare Werken aangeboden, ingevoegd artikel 1 van het besluit van Zijne Excellentie den Gouverneur-Generaal, dd. 31 mei 1873, no. 24.
8 Idem, p. 1
9 Idem, p. 2
words, “excellent German railway technicians”, he introduced a new research approach, namely ‘Terreinopname’ (terrain survey). He wrote:

‘De hoofdrigtingen ja de eindpunten des te projecteeren spoorwegen zijn niet gegeven; het programma voor den weg, dat gewoonlijk den ingenieur gegeven wordt, moet hier worden vastgesteld, in den strijd der spoorwijdten moet hier beslist worden.
De gegevens, welke de terreinopname zal verschaffen, zullen de gronden geven, waarop de besissing omtrent genoemde kwesties moet berusten.
Ik gebruik met opzet het woord ‘terreinopname’, omdat mijns inziens ook het traceren van den spoorweg geheel en al moet berusten op, ja bijna bestaan uit uitgestrekte terreinopname’
(Cluyysenaer, 1873: 4)

(The main directions, yes the end points of the railways to be projected are not given; the program for the road, which is ordinarily given to the engineer, must be established here, in the battle of the spurs it must be decided here. The data that the terrain survey will provide will give the grounds on which the decision on these issues must rest. I deliberately use the word ‘terrain survey’ because in my view the tracing of the railroad must entirely rest on, yes almost consist of, extensive site survey)

Cluysenaer further developed his research. First he explored the total area, from the coal mines to the coasts, with two superintendents. The engineers, Verwey, Van Hees and Snethlage, joined him after their arrival in Sumatra. Based on these explorations, a specific area was selected for detailed observation. His team was divided into two teams, one headed by Verwey and the other by Van Hees. They were supported by the superintendents and a large number of local free labourers and together systematically surveyed the whole area. The collected data was processed by personnel at the headquarters in the city of Padang. By the second half of 1874 it had become necessary to expand the number of teams to three. Snethlage was appointed as the third team-engineer and tasked with surveying the Padangse Bovenlanden area. Within three years the entire area had been surveyed and the most optimal track and location of the harbour, based on the collected data, was selected. In terms of the coal mine an anonymous mining engineer was involved. He delivered the data for the location of the mine as well as the location of the housing for the

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10 For example, in the first six months of 1874 the average number of labourers working per day are as follows: January: 496 labourers per day, February: 390, March: 281, April: 344, June: 175. Most of these workmen (approximately 729) were employed on 7 and 8 January. For the working force and other various expenses, an amount of f 31417.48 was spent in the first six months. There is no indication, however, of the exact amount spent on the working force. J.L. Cluysenaer, Overzicht van den stand der werkzaamheden aan het einde van de eerste helft van het jaar 1874 opgemaakt etc. p. 1-2.

11 Idem, tweede helft 1874
personnel. In this way, the railway line would be well connected to the mine for coal transportation.\textsuperscript{12}

During these three years, the team encountered health problems and the work was performed under harsh conditions. However, all the engineers involved and most of superintendents were able to complete the project in 1875. One can imagine that working in this setting, in a remote area far away from home over a three-year period, resulted in the development of close relationships between team members.

In 1875 Cluysenaer presented the design of the railway line, which would run via the Subang-pas. The design also included the coal mining and the construction of the harbour in the Brandewijnsbaai, south of Padang. The estimated cost was 25 million guilders. Cluysenaer suggested that the government develop the project for economic reasons because in the first years the return on investments would only be 2.3%. He argued that no private entrepreneur would be able to raise that amount of money with such meagre prospects.\textsuperscript{13}

In 1876 Cluysenaer returned to Breda, where he was employed as a teacher at the Koninklijke Militaire Academie (KMA, Royal Military Academy). However, in 1878 he left the KMA to join the Maatschappij tot Exploitatie van de Staatsspoorwegen (Society for the Exploitation of the State Railways) where he continued his career until 1886.\textsuperscript{14}

The railway line in Sumatra continued to dominate his thoughts. In 1878 Cluysenaar published a second report in which he suggested a railway network in the Padangse Bovenlanden, which would be connected to the main railway line from the coal mines to the harbour. To build this extended design another 9 million guilders were needed. In the same year, a third report followed in which he suggested an innovation in railway technology, the rack railway. He was convinced that this innovation, by N. Riggenbach, was suitable for Sumatra to overcome the height difference between the coal mine and the harbour. He suggested that this rack railway be implemented through the Aneh gap.\textsuperscript{15}

\textsuperscript{12} Idem, for the years 1873, 1874 and the first half of 1875.
\textsuperscript{13} Colombijn (1992) p. 442-443.
\textsuperscript{14} A.J. Veenendaal jr., ‘Cluysenaer, Jacobus Leonardus (1843-1932)’, in Biografisch Woordenboek van Nederland. \url{http://resources.huygens.knaw.nl/bwn1880-2000/lemmata/bwn2/cluijsenaar}
\textsuperscript{15} Colombijn (1992) 443; A. J. Veenendaal jr. ‘Cluysenaer’.
Colombijn criticized these reports. He suggested that the designs were made without any measurements in the field and he mockingly described these designs as a hobby of the engineers. However, this ‘new’ research approach generated a pool of relevant data from the entire area concerned. In other words, Cluysenaer could design alternative routes from behind his desk using this data. The new extended design of the route would ‘only’ cost 24.5 million guilders. This, however, was still too expensive.

Due to the high costs, the Aceh War (1873-1914) and the construction of railways on Java, the government was unable to implement the project. It was only in 1887 that the government decided that construction should be undertaken under state supervision and the go-ahead for the start of the project was given. On 17 September 1887 one of the engineers from Cluysenaers’ team, J.W. IJzerman, became the chief-engineer of the ‘Dienst der Staatsspoorwegen ter Sumatra’s Westkust’ (Service of the State Railways on Sumatra’s West Coast). Finally, the exploitation of the Ombilin Coal mines was started from 1891 onwards. In 1892 this service was placed under the ‘Mijnwezen’ (the Mining Bureau), where IJzerman was in charge of the exploitation of the Ombilin Coal Mine until 1898.

A railway in Transvaal
In 1874 the Volksraad of the Zuid Afrikaanse Republiek (ZAR, South African Republic) appointed a commission to develop a plan, in cooperation with the government, for a railway line from Pretoria to a harbour located at Delagoa Bay in Portuguese Mozambique. The commission had already developed advanced plans when the ZAR was annexed by England in 1877. After the Transvalers freed themselves from English domination in 1881, the plan was picked up again. A Portuguese major of military engineers, J. Machodo, presented a design to Pretoria for a railway from Lourenço-Marques to Komatipoort on the border of the South African Republic. The government assigned him to measure the Komatipoort-Pretoria route.

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16 It was not obvious that the project would be carried out by the government. Following an extensive discussion in parliament, the matter was settled in favour of the government. See: Colombijn (1992).
17 Regeerings Almanak voor Nederlands-Indië, 1889, p. 455.
18 Regeerings Almanak voor Nederlands-Indië 1895, p. 405; Regeerings Almanak voor Nederlands-Indië, 1900, p. 437.
19 In Memoriam NZASM (1906) p. 4-5
The realization of this railway was troublesome, not only in terms of the financing but also the opposition encountered by the English and the American entrepreneur McMurdo, who resided in London. McMurdo had acquired a concession from the Portuguese government to construct a railway line from the harbour to the border of the ZAR and was able to enforce stringent conditions with respect to the construction of railway lines of other companies. The issuance of this concession to McMurdo had a large impact on the construction of the planned railway from Pretoria to Lourenço Marques. Although too extensive to elaborate on in this paper, the activities by McMurdo proved to be disastrous in terms of raising the funds and realizing the railway. This report instead focuses on the role Cluysenaer played in the realization of the railway.

In 1883 President Paul Kruger accompanied a delegation to the Netherlands to find a Dutch contingent willing to build the railroad on reasonable conditions. They succeeded and a committee of prominent Dutch citizens indicated their willingness to acquire the concession. For various reasons, the committee was unable to raise the required capital and was later dissolved. Three railway men, who were part of the committee, wanted to

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20 Read more in: In Memoriam NZASM (Amsterdam 1908) pp. 4-14; and RC de Jong, G-M van der Waal and D.H. Heydenrych, NZASM 100 1887-1899 the buildings steam engines and structures of the Netherlands South African Railway Company (Pretoria 1988) pp. 23-34.

take over the concession.\textsuperscript{22} They were J. Groll (1814-1885), D. Maarschalk (1829-1886) and R.W.J.C. van den Wall Bake (1843-1910). Groll started his career as a commissioned officer in the Dutch Navy. He continued at several railway lines in the Netherlands East Indies.\textsuperscript{23} Maarschalk was an engineer educated at the KMA (Royal Military Academy).\textsuperscript{24} After 1868 he became involved in the construction of several railway lines in the Netherlands East Indies while Van den Wall Bake also worked at several Dutch railway companies. The NNBW does not make reference to his education but only that he started his career in 1863 as an adjunct mechanic engineer\textsuperscript{25} and in 1884 was appointed as director of the Bataviasche Oosterspoorlijn.\textsuperscript{26}

In order to be more successful in raising capital for the railway, Groll, Maarschalk and Van den Wall Bake adapted the design and shortened the track. Instead of Pretoria they chose to build the route from Nelspruit to the harbour in Lourenço Marques. During the funding negotiations, two concessionaires successively died within one year, first Groll at the end of April 1885 and then Maarschalk on 13 April 1886. Van den Wall Bake was left as sole concessionaire and had to find new partners. In a letter dated May 1886 to the government in Pretoria he wrote that he had been successful in this regard.\textsuperscript{27} Groll’s eldest son, J.F. Groll, who was an architect in London, had offered himself as a concessionaire. Van den Wall Bake accepted his offer but would have preferred J.L. Cluysenaer, who he described in a letter as a generally competent and respected railway engineer familiar with railway construction in highlands due to his stay in the Netherlands East Indies and his research in Sumatra. He was

\begin{thebibliography}{9}
\bibitem{22} In Memoriam NZASM (Amsterdam 1908), p.8.
\bibitem{23} Johannes Groll, Nieuw Nederlands Biografisch Woordenboek (NNBW) deel 8, pag. 636  
\bibitem{24} David Maarschalk, NNBW, deel 5 pag.327-328  
\url{http://resources.huygens.knaw.nl/retroboeken/nnbw/#source=5&page=171&view=imagePane&size=1219&accessor=accessor_index} en Nationaal Archief, Den Haag, Nederlands-Zuidafrikaanse Spoorweg Maatschappij, nummer toegang 2.18.18.02, inventarisnummer 2, Stamboek en andere loopbaangegevens David Maarschalk.
\bibitem{25} If he studied in Delft, which is not confirmed, he would have graduated in the same year as Cluysenaer, but in a different discipline, namely mechanic engineering. This needs further research.
\bibitem{26} R.W.J.C. van den Wall Bake, CBG01: 27 and Bake, Rudolf Willem Jan Cornelis van den Wall, NNBW, deel 8, pag. 42.
\end{thebibliography}
very pleased that he could inform the government in Pretoria that Cluysenaer agreed to become a concessionaire. Groll and Cluysenaer became concessionaries in 1886.

The three men succeeded in raising Dutch and German capital. On 21 June 1887, the Nederlandse Zuid-Afrikaanse Spoorweg (NZASM) was founded with acting directors Van den Wall Bake and Cluysenaer. J.F. Groll left the arena for unknown reasons.

The Eastern Track: Nelspruit-Komatipoort

After the founding of the NZASM, the directors in Amsterdam started planning the construction of the railway. Cluysenaer recruited the personnel and one of the first people he recruited was engineer R.A.I. Snethlage, who was also involved in West-Sumatra. In March 1887 Snethlage was sent to ZAR to explore the most desired railway route and to consult with the government about the final destination. During his stay in ZAR Snethlage was appointed chief-engineer. In the meantime, Cluysenaer selected a team to undertake the surveying, of which Cornelius Groll, a younger brother of J.F. Groll, was a member. Unlike his father, Cornelius was a civil engineer who graduated in Delft. In addition, Cluysenaer appointed J.E. van IJsendijk as the engineer, and A. van Lennep, G.H. van der Meulen and TH. W. L. Steinmetz as the deputy engineers. This team was tasked with surveying the first part of the railway line along with the required construction parts in order to start the construction in the Spring of 1888. In the meantime, Snethlage consulted the Government of the Republic, which preferred Nelspruit as the final destination.

On 28 July 1887 the engineers left the Netherlands and settled around Komatipoort in the middle of November. Here a home was built for them by the Company. The team started with the survey in November but after a few months the engineers became the victims of malaria and two of them, Van IJsendijk and Van der Meulen, died. The other members went to Pretoria to recover. Snethlage returned to Holland and resigned.

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28 In Memoriam NZASM (1908) 8-9.
29 Archief NZASM, Nationaal Archief, Inventarisnummer 228, Personeelsdossiers nrs. 1-33
30 Archief NZASM, Nationaal Archief, inventarisnummer 221, Jaarverslag 1878.
31 Algemeen Handelsblad 17 oktober 1912, Overlijdensadvertentie Wilhelmina Henriette Temminck, weduwe van J. Groll.
32 Archief NZASM, inventaris nummer 221, Jaarverslag 1887.
A new chief-engineer was needed and Cluysenaer approached Willem Verwey Azn, another engineer who was involved in Sumatra. In order to obtain more information about the project, Verwey visited Snethlage in The Hague in March 1888 and found him to be depressed. Despite this, Verwey was impressed by the chief engineer. According to Snethlage, Verwey wrote that the NZASM had put itself in a hornet’s nest. It wanted to construct a railway line in an unfavourable, uninhabited area, without a design, and without being able to calculate the costs and the construction time. In addition, the railway line would be constructed in a killing climate with inexperienced personnel, without a connection to the sea or any other means of transportation, with little help from others, where building material was not available, and where life had nothing exciting to offer, while the majority of the country preferred the railway to be built in another direction. The sudden death of the two young engineers was the final straw. In short, he looked up to the work.\(^{34}\) It is not surprising that Verwey had to carefully consider Cluysenaer’s offer, but finally he agreed.

In Pretoria, Groll took the lead and reported frequently to Snethlage. He continued the surveys with a team. A German mining engineer, L. Bühner, was added to the team to investigate the presence of coalfields,\(^{35}\) which would assist in determining the route of the railway.\(^{36}\) Groll was discontent with Verwey’s appointment as he believed that he had worked very hard and taken responsibility for the work performed by the team. In fact, he had done the work of the chief-engineer.\(^{37}\) However, Cluysenaer overlooked him for this position, giving preference to a former team-engineer of the project in West-Sumatra. Groll resigned and left South Africa. On 28 June 1890 he was appointed temporarily as section chef at the Staatsspoorwegen in Java.\(^{38}\)

The new Chief Engineer departed from the Netherlands on 26 July with his family and was due to start in his position at the end of August 1888.\(^{39}\) To bridge this period, Cluysenaer departed in April from the Netherlands to temporarily lead the project of the Eastern line.

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\(^{34}\) Archief NZASM, inventarisnummer 283 Officieuze brieven van de heer W. Verwey. 1888-1892.

\(^{35}\) In Memoriam NZASM (1908) p. 72.

\(^{36}\) Archief NZASM, inventarisnummer 423, Brief Verwey aan Cluysenaer, Pretoria 14 december 1888.

\(^{37}\) Archief NZASM, inventarisnummer 423, Baberton, Brief Groll aan Verweij, 24 november 1888 Ontslagaanvraag.

\(^{38}\) Regeringsalmanak voor Nederlandsch-Indië, 1891, p. 432.

\(^{39}\) Archief NZASM, inventaris nummer 221, jaarverslag 1888.
The Rand Tram and Spring Coal Mine

The developments around the Eastern line had become extremely frustrating to the NZASM, due to the difficulties with McMurdo. Fortunately other opportunities arose. In 1886 gold was discovered in Witwatersrand. The gold mining industry was developing and there was a pressing need for infrastructure, especially a railway line. Ox-wagons could no longer cope with the needs of the mines and coal was needed for the use of steam-driven ore-crushing and hoisting machines. The nearest coal mine was situated in Boksburg, some 27 kilometres to the east of Johannesburg.\(^{40}\)

Shortly after his arrival, Cluysenaer heard of the pressing need for a railway line from Boksburg to the Rand. He was able to obtain the concession for the construction of the railway line, as well as the exploitation of the Boksburg coal fields in July 1888.\(^{41}\) Again an area survey was undertaken to collect data. On the basis of this data, the railway line was designed for the Boksburg-Elandsfontein-Johannesburg line. A far larger area than necessary was, however, surveyed for the Rand Tram and a possible extension of the railway line to Springs was included as well as data for future possible extensions.

Cluysenaer assigned Bühner to develop an exploitation plan for the coal mine.\(^{42}\) Just as in Ombilin, the mining engineer had to specify the exact location of the mine and the housing for the personnel, taking into consideration future building developments, in order for the railway line to be connected efficiently. In June 1889 Bühner wrote that the exploitation of the coal mine would take at least another year before it would come into full effect. For the furnishing of the mine and the selection of miners he needed the advice of the mining expert H. Wipperman from Essen in Germany.\(^{43}\) Cluysenaer was initially somewhat reluctant to use Wipperman’s services but after more information from Bühner and a meeting between the two men in Amsterdam, Cluysenaer was prepared to meet Bühner’s request.\(^{44}\) Through


\(^{41}\) In Memoriam NZASM (1908) 10-11.

\(^{42}\) Archief NZASM, inventarisnummer 443 Kolenmijn Springs, Brief Cluysenaer aan hoofdingenieur Pretoria, Amsterdam, 28 november 1888.

\(^{43}\) Archief NZASM, inventarisnummer 443 Kolenmijn Springs, Brief Bühner aan Verwey, d.d. 7 juni 1889

\(^{44}\) Archief NZASM, inventarisnummer 442 Kolenmijn Springs, Brief Cluysenaer aan hoofdingenieur Pretoria, d.d. 10 juli 1889 en idem, d.d. oktober 1889
Wipperman, the mining equipment was ordered at the Humboldt factory in Cologne-Kalk, Germany while professional German miners were also recruited.  

Finally the quality of the coal from Springs had to be researched. In January 1890 Verwey wrote to Amsterdam that he was not able to present a similar report to the one produced for the Ombilin coals from Bühner and the mechanical engineer Van Hasselt.  

The Rand Tram was opened for traffic on 17 March 1890. The working of the line proved to be very lucrative. The Springs Coal Mine started producing with temporary equipment from 1889 onwards and by the end of 1890 it was using the equipment from the Humboldt factory. However, the Springs Coal Mine was difficult to exploit. Another coal field, Geduld, proved to be satisfying in terms of both quality and quantity of coal produced. The Springs Mine was closed and the NZASM continued exploiting the Geduld coal field. On 21 June 1899 the mine was closed and the personnel dismissed.  

In the meantime, at the end of 1889 the surveys on the other line continued under Verwey’s supervision. He brought order to the teams’ work, both in terms of the data collected and by introducing the rack railway at Elandsspuitvallei. Like with West-Sumatra, he changed the original route of Machodo which was much cheaper to build.  

Therefore, during the period from 1886 onwards, Cluysenaer was the director of a private company. He was very successful in the development of the NZASM, especially the Rand Tram as well as in terms of the exploitation of the coal mine. This success was probably the reason for his application for a concession in September 1889 as director of the NZASM together with P.J. van Houten for the exploitation of the Ombilin coalfields and the railway line. This concession however was not granted because, as already mentioned, parliament decided to hand the exploitation to the government.  

45 Archief NZASM inventarisnummer 443 Kolenmijn Springs, Brief Van den Wall Bake aan de hoofdingenieur in Pretoria, d.d. 24 december 1889.  
46 Archief NZASM, inventarisnummer 443 Kolenmijn Springs, brief Verwey aan Directie NZASM Amsterdam, Pretoria 17 januari 1890, met bijlagen.  
47 In Memoriam NZASM (1908)72-74.  
48 Archief NZASM, inventarisnummer 471 De tandradbaan.  
49 Archief Ministerie van Koloniën, inventarisnummer 4306.  
50 Idem: pp. 448-449.
In November 1889 Cluysenaer resigned unexpectedly as director of the NZASM to become director-general of the Maatschappij tot Exploitatie der Staatsspoorwegen (Society for the Exploitation of the State Railways). In the minutes of the Extraordinary Meeting of Shareholders on 14 November 1889, the chairman of the meeting proposed that Cluysenaer’s resignation be accepted with the most honourable dismissal under thanks for his many and important services rendered to the NZASM.51

The Ombilin Coal Mines: a model for the NZASM

The Ombilin Coal Mine, with its railway for the transportation of coal and harbour, was the first great assignment for Cluysenaer as an engineer in a leading position. During this period he introduced a new approach, i.e. the ‘area survey’, to systematically determine the most optimal route for a railway line. In West-Sumatra he combined the exploitation of the coal mine, the railway and the harbour in a coordinated, efficient system. The research was performed by a well-organized and close-knit team. Some ten years later Cluysenaer became the director at the NZASM. In the development of the railway line he applied the same approach as in West-Sumatra: a broader survey, a detailed survey for data collection, and then the designing of the optimal railway line route based on this data.

In the dissemination of this scientific knowledge, Cluysenaer, Snethlage and Verwey were important roleplayers. Cluysenaer, with his ideas, managed the organization from Amsterdam and for a few months from Pretoria. Snethlage and especially Verwey executed the assignments. Their experience in West-Sumatra is crucial in the development of the NZASM railway lines. Verwey was able to manage the teams successfully in the field. It is evident that this method was applied to the development of the Rand Tram and the Springs Coal Mine.

The approach used by the NZASM engineers became known as the NZASM way of design and was adopted as the quality standard for the design of railways in the ZAR, when the government wanted to outsource the construction of railways to other companies.52 However, we may conclude that this is not the NZASM design, but the design that originated from the Ombilin Coal Mines project. The applied methodology, however, is invisible to the

51 Archief NZASM, inventarisnummer 220, Notulen der Buitengewone Algemene Vergadering van aandeelhouders, gehouden op 14 november 1889.
52 In Memoriam NZASM (1908) 43.
spectator but is evident in a system of railways, buildings and coal mines and even a harbour. We must cherish this heritage.