THE HUMAN FACTOR IN ASSET MANAGEMENT PROCESS DEVELOPMENT

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ABSTRACT

In the Netherlands, the liberalization of the energy markets started in 1999. As income reduction was part of the regulation of network companies, Essent Netwerk has been working on decision making process to keep up with the regulatory demands. In the early years, the focus was on reducing costs by postponing investments as long as possible. However, some of the investments were not needed at all, so gradually the focus changed from postponing investments to selecting the right investments. In this process, Essent Netwerk discovered that almost no control existed on which investment proposals were generated. It was not certain that the highest risks in the network were tackled. As the concern for quality became part of the regulation, Essent Netwerk adjusted for this deficiency by introducing broad risk identification sessions and prioritizing the risks for mitigation. Unfortunately, the complexity of this full scale, sophisticated asset management process was much larger than most employees could manage. This forced Essent Netwerk to simplify the process. The potential loss of quality of decisions in this simplification would be more than compensated by the sheer volume of people working by the process. A first experiment was in allowing different levels of sophistication based on uncertainty and complexity, but it proved difficult for the engineers to determine which level of sophistication was needed. To overcome this hurdle an analysis of the types of decisions was made, and per type the level was set. This was then formalized in the process descriptions, which were in turn the basis for certification on the basis of PAS55 and ISO 9001. Anticipated future developments include stakeholder involvement in the process to build trust in the company.

INTRODUCTION

In the Netherlands, the liberalization of the markets started in 1999. One of the first steps was to split the distribution activities from the retail activities. Retail activities would be subject to market forces, but as networks are natural monopolies, a regulator would simulate those. The mechanism used for this was pricecap regulation, where the income is decreased because of supposed efficiency improvements. Even though the network companies had a built a tradition in the 90s for postponing investments as long as possible, this outlook was quite threatening. For example, in the UK the income of the network companies was reduced by almost 50% between 1999 and 2001[1]. The companies felt that their tradition of postponement would not be enough to deal with such significant changes. Asset management was introduced as a better way to balance the needs.

In this paper we will look at the development of the asset management process as it took place in a large Dutch Network company, Essent Netwerk. First, we will look into the history of decision making in the companies and build understanding of why they were as they were in the start of the liberalization. This will result in a review of the process that was in use. We will address the pitfalls of this approach, and see that it was not really designed for dealing with the significant change the new situation might pose. A major reason was that the organisation did not promote using the nil-option as a reference. In the next section we will look at how EN took a first step in changing this. Due to a concurrent increase in risk awareness of society, this step was not enough, and we will discuss why. Section 4 describes the expansion of the process to deal with those new requirements. This was in line with all existing asset management theories and best practices, but in practice it proved very difficult to run. This led to a new review of the process to understand why it would not work. Again, the human factor proved to be the driver. The new process was simply too complex to be useful for most of the engineers. They needed more guidance than just the general principle of balancing stakeholder needs over all business values. Section 5 describes the way this guidance was provided. This worked so well that this new process model facilitated certification against PAS 55 [2] and ISO 9001[3]. The experiences with certification led to the conviction that the process was the key element in building trust with the stakeholders. In the final section we will discuss some possibilities of involving the stakeholders in the process.

HISTORICAL CONTEXT

The current networks in the Netherlands date back to the 60s and 70s. The high economical growth in this period led to an ever increase in the demand for energy. Growth figures were as much as 10% annually over an extended period[1]. This means the demand doubles every 7 years. Besides this enormous growth of demand, another major operation took place. Traditionally, the medium and low voltage grids, which are were built largely as an overhead network, were put under ground. Finally, in 1963 a large amount of natural gas was found in the Netherlands, the so called Slochteren field. The gas was made available to all households via a gas distribution network, which did not exist yet.

The enormous need for new infrastructure meant that companies were struggling to keep up with demand. In such circumstances it does not make sense to challenge the investment. But there are logical reasons for it too. For example, if demand doubles every 7 years, anything that is not needed this year will be needed next year or perhaps the year after. On the total life span of more than 30 years this potential error of 1 or 2 years is not important, and not worth the effort of reconsidering.

[1] Demand increased from 11 TWh in 1960 to 45 TWh in 1975, an average annual compounded increase of 9%

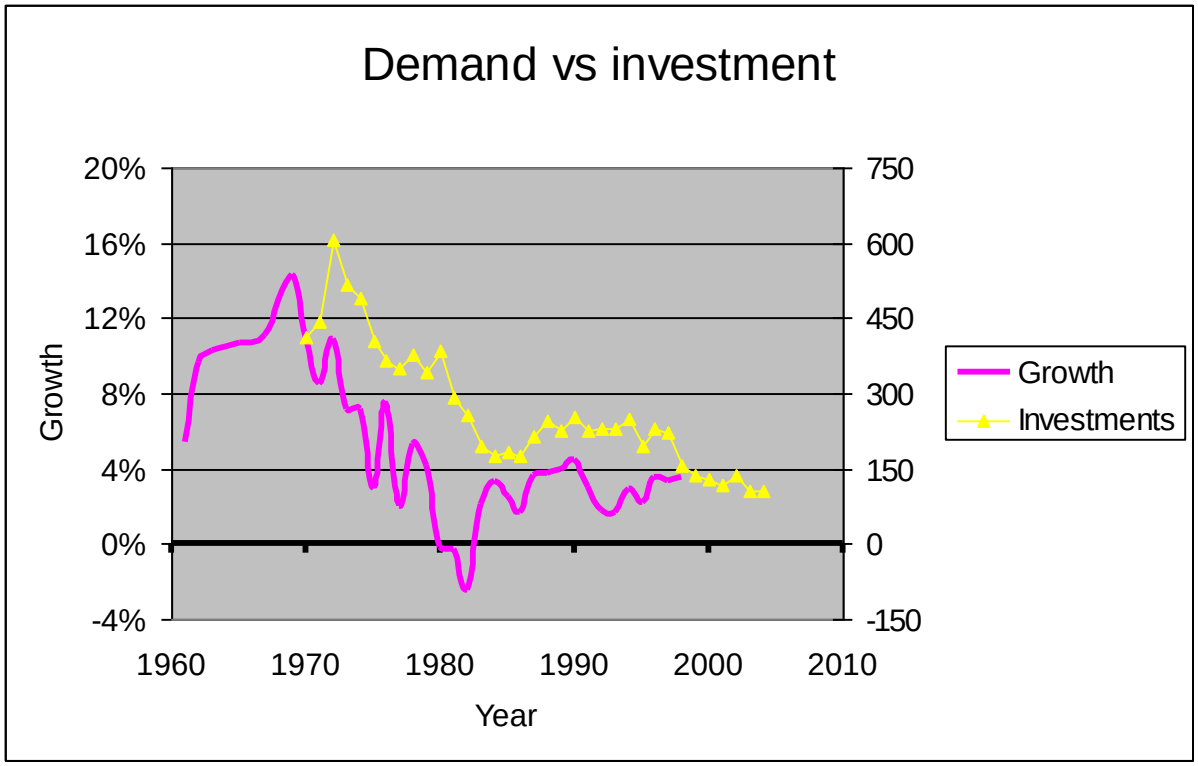

Figure 1: Investments lag demand growth, and are maintained even if growth is negative [4]

However, these conditions of extreme growth came to a sudden stop in the late 70s, early 80s. This was partly because the economic growth collapsed, and partly because people became aware of the scarcity of energy due to the oil crisis and the reports of the Club of Rome[5]. That resulted in efforts to reduce the use of energy. But this was not immediately recognized by the energy companies. Therefore, construction rates were maintained even though there was no real demand for it, resulting in huge overcapacities. In hindsight this is not smart, but perhaps we should think of it differently. A huge amount of staff was employed to construct the new infrastructure. They were still present in the companies. The social climate was not such that their employment could be terminated immediately. Construction rates were only gradually decreased. When the economic growth picked up again, it could be matched with relatively low efforts of the companies. This can be seen in the figure above. But to do this a critical review of investment proposals was needed. Asset management avant la lettre was born.

THE EARLY AGES OF ASSET MANAGEMENT

The basic principle used for asset management was challenging expenditure. Engineers would come up with investment proposals[2], which would be critically reviewed. If the investment proposal was approved it would be implemented and evaluated. This process is shown in the figure below.

[2] In the context of this paper, any expenditure for constructing or maintaining the infrastructure is regarded as an investment.

Figure 2: the heritage asset management process

This process was still in place when the liberalisation of the markets happened. As the proposed price cap regulation would drive down the income of the companies, some savings would have to be found. In a process as mentioned above this can be achieved by putting more effort in challenging the proposals. As a result, less projects would be approved. However, this could also mean that some serious problems would not pass the hurdle, therefore increasing the risk substantially. Therefore Essent Netwerk considered the option to review the decision making process. This led to some remarkable results.

First of all, the process above was hardly formalized. The basis for determining which proposals to develop was found in the design guidelines, but these were not universal in time and space. Engineers decided among themselves which proposals they would make, and try to get them approved. But even though it was described who could approve how much money, the grounds for approval was not described. The most important question for approval was whether the project could be executed for less money. If the proposal did not address any thoughts on this, the proposal was sent back. If a proposal was not accepted, this did not exactly boost the status of engineers among his peers. Therefore, they adapted to the question in the approval process in two steps. First of all, they learned that if they could cut costs off the initial proposal, it was likely to be accepted the next time. A very simple solution was to exaggerate the costs of the project, so that it could be easily trimmed[3]. But decision makes learned too! They anticipated that projects cost were overestimated, so increased the targets for savings. And as middle management was often recruited from the engineering staff, they would second guess and redesign. Another option was just to cut costs out of the project, and execute it as originally designed. The lack of evaluation meant this was not likely to have consequences.

The second basic question which was often asked in decision making on investments was whether the investment could be postponed. Besides giving the obvious answer “no, the world will stop turning if the projects is not executed” this was anticipated by putting the proposal on the agenda very early. For example, if a project developer requested infrastructure for a new business area, it would be immediately be included in the business plan. But those requests often take years to materialize. Provisions for those projects would therefore populate the business plans for years on a row. Apparently management did not mind, perhaps because not spending all budget was perceived as a sign of good management.

Another way to improve the likelihood of getting the proposal through approval was to include multiple solution. Each alternative would be described with pros and cons, but they did not necessarily address the same problem. This kind of presentation tempted the decision maker to choose the best alternative, even if the problem this solved was not worth any effort.

[3] Not only engineers behaved this way. The business plans always reserved more budget for investments than was actually spent.

Finally, persistence would often pay off. If a proposal was rejected the first time, entering the process again the next year, or with a different decision maker, would just bring new potential for improvement.

Below the major shortcomings are listed:
Unclear which problems were tackled, as engineers decided among themselves what to address
In challenging the proposals, often second guessing occurred, requiring major rework of the proposal.
Almost no process control, as the process was hardly defined.
Proposals not reviewed in the total business context
Budget approval on first come first serve basis
Rejection of proposals was only temporarily, projects would reappear next year.
Almost no ex-post evaluation of project costs or the delivered benefits

To summarize this, the analysis showed lots of efforts were wasted on ineffective activities, mainly because almost no formal problem analysis was being carried out. The one question to start this formal problem analysis is "What will happen if we don't do this project?" but it was simply never asked.

REVERSING THE PROCESS

The obvious solution to the lack of problem analysis was to start asking the one question "What will happen if we don't do this project?". This was formalized by reversing the first two steps in the decision making approach in the beginning of 2001.

Figure 3: Reversed process

This meant the engineers weren't allowed to start developing investment proposals until their problem definition was accepted. In this process the default outcome is doing nothing. To prevent engineers exaggerating the risks to get approval for their projects, EN added two measures. First, the responsibility for the risk was transferred to the management as soon as the problem entered the process. This reduced the perceived personal risk for the engineer in not being able to solve the problem. The second measure was to remove the budget limit in decision making in the first to allow any proven real problem, no matter how big or small, should be solved.

This reversal showed great advantages. Less time was spent on irrelevant issues, the resolutions to accepted problems were funded quite easily, and amazingly, the expenditures were reduced by about 15%, although the budget limit was relaxed. However, this approach revealed other shortcomings in the process.

First of all, we became aware we did not know all risks in the network. Different regions came up with different issues to address in the next plan. Even though there were differences in asset base between the regions, it was hard to believe the problem lists were so much apart. It was more like personal favorites (hobby horses) drove the list. Further support for this hypothesis could be found in the fact that we were surprised by some major incidents[4], not just meaning that we estimated its probability as very low, but more seriously that we were not aware of the risk.

Another shortcoming was that we still did not have a mechanism for choosing between proposals. Even if the proposals addressed real, significant issues, and were worth the effort of mitigating reviewed as such, were they the ones to target regarding the total portfolio? Because the proposals were reviewed on a case by case basis, prioritizing between problems was not facilitated, so budget would still be assigned on a first come first served basis. For the moment, the budget constraint was removed, so it was not really a critical issue. On the long term, however, this most likely could not be maintained.

Finally, some projects that had a thorough problem analysis attached and were definitively worth the effort were not completed according to the plan, either because of postponements or because of altered designs. This meant the risks were not mitigated as planned. Again, this could be explained by human behavior. In the old situation it was not that bad, proposals would show up years before the risk became urgent. This allowed the project implementers to do some planning of their own. But as the decision making was more on the edge, in the new situation postponement to fit the schedule better could seriously increase the risk. It led to the conclusion that for effective asset management more than only decision making had to change. Attention would have to be given to executing the projects.

RISK BASED ASSET MANAGEMENT

To address the issues mentioned above, the process was further developed [6]. The problem definition step was expanded to a risk identification and assessment phase. We defined the major values we cared about, and would perform a workshop with representatives from the entire company to find out how these could be threatened. Each of those threats would then be characterized by a description of their consequences if they occurred, and the likelihood of occurring, resulting in a risk. This characterization would take place in a discussion between the experts, taking advantage of all knowledge about the risk. By placing the threats in a risk matrix, they could be prioritized. The next step, formulating alternatives, also was moved to a more conceptual level. Instead of different designs for a specific problem in the grid, different strategies for the generalized problem (the risk) would be developed. For example, for the generalized problem of overloading assets two strategies exist, either upgrading the asset, or shedding load. After selecting the most effective strategy for the risk, it would be applied to the points in the grid where the risk could occur. With the use of an asset performance model, those points could be ranked according to their yield (=benefits per unit of cost), and only the ones above a certain mark would be executed[7]. By executing them according to the rank, it would guarantee that the highest risks were mitigated first. To emphasize the change in concept from project execution to risk mitigation, the name of this phase was changed to Investment Delivery. Finally, as the effects of the projects were predicted in much more detail, the evaluation of the projects could be taken to the next level. See diagram below.

[4] For example, Groningen 2003 and Steenwijk 2003

Figure 4: The risk based asset management process

A BRIDGE TOO FAR

However, despite all good intentions, this process proved too complex to be practicable.

For example, the risks we found in the workshops typically numbered in the 100s. Discussing 100 items with 10 experts in 3 hours time is simply impossible. Furthermore, the risks were not independent. Some would focus on the cause, which might drive different consequences, like overloading an asset could result in explosions, leading to outages or injuries, or just to increased ageing of the asset. Others would focus on the consequences which could be the result of different causes. Outages, for example, could be caused by overloading, internal failures, external influences like excavation works, operating errors and so on [8]. Both risks were valuable in their own right, but solving both of them would result in mitigating the risk twice. Beforehand, it was not possible to tell which approach was most effective. With some consideration, the risks could be compressed to a manageable number, but each parallel track would end up with a different set. This did not help external communication. Furthermore, the risks resulting from this compression were necessarily high over, which made it difficult for the engineers to connect. Besides, formulating strategies for high over risks would result in high over strategies, which could by no means compete with the design and operating guidelines, a body of knowledge which accumulated over decades of experience[5]. This also made it difficult to connect. Basically, the new approach did not help the engineers in solving local problems, which they still considered their core job. Only for risks not covered by those guidelines the process was considered valuable. These could be for example very large problems in the HV grid, or completely new types of problems. Of the portfolio, roughly 25% lend itself to the risk based approach, of which the major part was a qualitative approach and only a small part was the result of quantitative modeling.

Without the buy in from the engineering staff, the process could not be executed. A new approach had to be found.

DIFFERENT LEVELS OF COMPLEXITY

In a review of the decisions the engineers were involved in, EN found that they had some point. Most projects were way too small to justify the effort of precisely defining the problem and designing multiple alternatives, even if the problems were predefined in risks (which they were not because of the large number and inherent overlap) and alternatives in strategies. For an investment proposal still some translation would have to take place to address local circumstances. What was needed were simple rules of thumb, like single thresholds. For

[5] However, that did not mean that they were good in terms of yield, only that working according to them would result in a functioning network.

example, if a transformer is loaded above its nominal value, it should be replaced by a larger one. In other cases, those rules of thumb might be a bit more complicated. Building on the same example, if a transformer is loaded above its nominal value for more than 6 hours per day, and the overload occurs at ambient temperatures of more than 25 centigrade, it should be replaced with a larger one. Of course, determining the threshold values was a decision on its own. It was handled by many rounds of deliberation, and working values would only be adjusted in small steps. The risk based asset management process is the advanced level, which is too complex for most decisions. Only in specific circumstances, like very large projects, or the availability of different types of options, a full quantitative risk analysis was really needed. Finally, only the selection of the investment portfolio should be approached on the systemic level. The scheme is presented in the figure below.

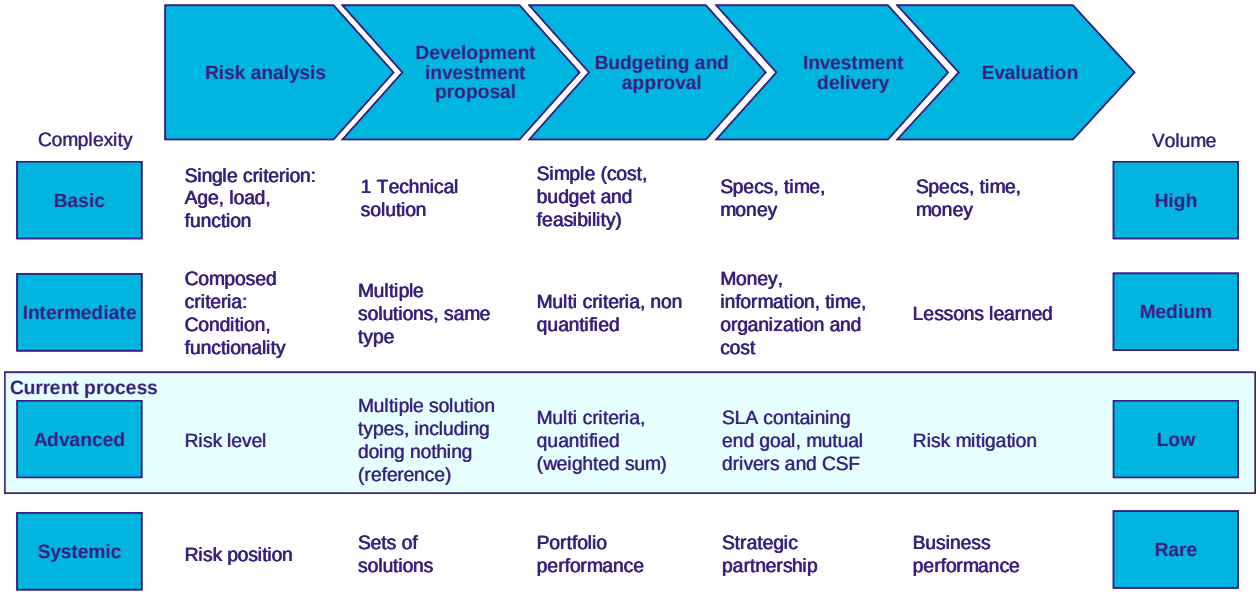

Figure 5: Recognizing different levels of complexity in decision making

However, what is absent in the scheme is determining the thresholds in the two simpler processes. On close inspection, those are often systemic decisions as well. And this was the clue to simplifying the process. Allow small projects to be approved on a rule of thumb base, but make certain the rules of thumb are based on a risk analysis and not on the opinion of a group of experts. For the time being, the expert opinion based rules would be maintained, but gradually they would have to be replaced by risk based rules.

APPLYING THE COMPLEXITY LEVELS TO THE WORK STREAMS

So far, we have reviewed the complexity of the decisions an asset manager has to take. Now it is time to match those levels with the types of decisions an asset manager has to make. These range from decisions on connections, new infrastructures, replacements, upgrades, maintenance to decisions on the guidelines. The complexity a decision needs depends on a few characteristics. First of all, decisions regarding a expensive projects require more quality than decisions on small amounts. The same holds for the size of the design space. If only 1 option is available, the decision becomes very simple, but if multiple alternatives exist (and they differ significantly in outcome!) better methods are needed. Finally, for practicability reasons, decisions that originate in the outside world (like connections or faults) require a

faster reaction than decisions that can be planned ahead and therefore should be more simple. In the table below the types of decisions are assigned a required complexity level based on those criteria.

	Processes	Certainty	Financials	Volume	Design Space	Complexity level
Control	Maintenance concept and replacement strategy	Prognosis	100 M	Low	Large	Systemic
	Network planning	Prognosis	150 M	Low	Large	Systemic
Primary	New connections:small	Prognosis	50 M	High	Small	Low
	New connections:medium	Prognosis	25 M	Medium	Medium	Intermediate
	New connections:large	Prognosis	10 M	Low	Large	Advanced
	New Infra	Prognosis	25 M	High	Medium	Intermediate
	Infra Upgrade	Planned	25 M	High	Medium	Advanced
	Maintenance	Planned	25 M	High	Small	Low
	Reconstructions	Prognosis	25 M	Medium	Medium	Intermediate
	Replacements	Planned	50 M	Medium	Medium	Advanced
	Failures	Prognosis	25 M	High	Medium	Intermediate

Figure 6: Volumes per work type (order of magnitude)

A special category in the scheme above is formed by the two upper processes. What distinguishes them is that they are indirect decisions. They determine which decisions should be taken (the planning) or how they should be taken content wise (replacement strategy).

This division was used for certification against pas 55 and iso 9001. As the engineers could understand by heart why the process was as it was, getting the certificates was relatively easy. The certification project started in September 2005, the first part of the certificate was achieved at the end of the year (final audit, not the real certificate) and full certification was reached in june 2006 (again final audit, not the true certificate), The total project only took 9 months, and EN was the second company world wide to achieve the PAS 55 certificate. This would not have been possible without a process that was so close to what the engineers could connect with.

FUTURE OUTLOOK

One of the risks addressed with this new process was the replacement problem EN was facing. Due to a large peak in the construction of the assets in the 70s a similar peak in the end of life could be expected. The assumption was that all network operators faced the same problem. Working together in close coordination with the local governments could mean huge savings. To get those parties involved an open approach was needed. In discussions on this subject, the insight emerged that stakeholders could not be convinced by delivering results on short time. Investment programs typically take 5-10 years to be completed. The stakeholders would have to trust the process by which the decisions were made, and that might require involvement in early stages of the process. Future evolution of the process therefore might be on opening the process for influences of the outside world.

CONCLUSION

Essent network has been developing its asset management process since the start of the liberalization in the Netherlands in 1999. Each step was characterized by the application of decision making theories, but in the end the human factor determined what was practicable. We think this is generally applicable. A sophisticated process that is theoretically perfect has almost no added value to a company, as only a few of the staff will be able to apply it. On the other hand, a simplified process that is perhaps 90% right, but is followed in all decisions delivers lots of value. A very visible value is the potential for certification against PAS 55. But also in financial terms this approach is more valueable. Being 90% right in all decisions is more valuable than being 80% right in 99% of the decisions and 100% right in 1% of the decisions. However, making the right simplifications is a complex task. Companies face the decision whether they employ the talent for analyzing complex problems on solving complex problems in the grid, which have a direct benefit of improved decisions, or on solving the complex organizational problem, which will only result in better decisions over time. Essent Netwerk strongly believes the choice should be on the long term investment, ie working on simplifying the process. This will in the end the most value, and will create the option of getting the stakeholders involved. In the potentially large changes in the future regarding the replacement of the assets they might be needed as an ally.

References

[1] Electricity Association, *Electricity industry review 4*, 2000.
[2] IAM, "PAS 55 Part 1: Specification for the optimised management of physical infrastructure assets," 2004.
[3] CEN, "Quality Management Systems - Requirements (EN ISO 9001:2000)," 2000.
[4] Y. C. Wijnia, M. S. Korn, S. Y. de Jager, and P. M. Herder, "Long Term optimization of asset replacement in energy infrastructures," presented at 2006 IEEE Conference on Systems, Man, and Cybernetics, Taipei, Taiwan, 2006.
[5] D. H. Meadows, D. L. Meadows, J. Randers, and W. W. I. Behrens, *The Limits to growth: a global challenge*: Club of Rome, 1972.
[6] IAM, *International Infrastructure Managament Manual*, V 2.0, UK 2002 ed: UK Institute of Asset Management, 2002.
[7] Y. C. Wijnia and J. P. Warners, "Prioritizing investment. The value of portfolio decisions in electricity infrastructure management," presented at 29th IAEE Annual International Energy Conference 2006: 'Securing Energy in Insecure Times', Potsdam, 2006.
[8] Y. C. Wijnia and P. M. Herder, "Modeling Interdependencies in electricity infrastructure risk," presented at 1st Annual CZAEE International Conference “Critical Infrastructure in the energy sector: Vulnerabilities and protection”, Prague, 2004.

This paper is an extension of earlier work:

Y. C. Wijnia, "The challenges of building a risk based Asset Management organisation," presented at IAM Exchange, London, 2004.
Y. C. Wijnia, "The Challenges of a risk based asset management organisation," Strategic asset management, pp. 832-837, 2004.
Y. C. Wijnia, "Asset management for dummies: Skills Development, Education and Motivation in a changing AM environment," presented at IAM Exchange, 2005.