

<b>School/Department:</b>	<i>Erasmus School of Economics / Econometric Institute</i>
<b>Project Title:</b>	<i>Approximate Dynamic Programming and Reinforcement Learning for Spare Part Control Towers</i>
<b>Abstract:</b>	<p><i>In a service control tower real-time information is collected on the supply chain of spare parts. The control of these supply chains is often done by tactical inventory models in companies. These models help to determine good target stock levels, reorder quantities and give advice on whether emergency shipments are needed. As on a tactical level all possible situations need to be considered, the models used are often limited in options. As such they can often not give advice for the specific situations that occur in control towers. Hence new models are needed that can handle a multitude of information in order to give advice.</i></p> <p><i>The idea behind the project is the development of these models for real situations in control towers using approximate dynamic programming (ADP) and / or reinforcement learning. The ADP technique has been developed in the last decade and is able to analyse high dimensional state spaces, which are likely to occur in the situations sketched. Unfortunately, there is not yet a standard approach in ADP, hence several approaches need to be developed and tested. Several advances have been made with Reinforcement learning and with it models with much larger state spaces can be solved.</i></p> <p><i>Short description of your achievements or relevant information</i></p> <ol style="list-style-type: none"> <li>Engin Topan, Ayse Sena Eruguz, Weina Ma, Matthieu van der Heijden and Rommert Dekker, (2020), A review of Operational spare parts planning methods for service control towers, <i>European Journal of Operational Research</i>, 282 (2), p. 401-414.</li> <li>Sha Zhu, Willem van Jaarsveld and Rommert Dekker, Spare Parts Inventory Control based on Maintenance Planning (2020), <i>Reliability Engineering &amp; System Safety</i>, (193), 106600.</li> <li>Hekimoglu, M., Dekker, R, and Van der Laan, E. (2018). How Random Lead Time and Disruptions Hurt Spare Parts Supply Chains? <i>European Journal of Operational Research</i>, 269, 909–922.</li> </ol>

	<ol style="list-style-type: none"> <li>4. Engin Topan, Tarkan Tan, Geert-Jan van Houtum &amp; Rommert Dekker (2018), Using imperfect advance demand information in lost-sales inventory systems with the option of returning inventory, <i>IIE Transactions</i>, 50:3, 246-264, (P).</li> <li>5. Kim, Thai Young, Dekker, Rommert and Heij, Christiaan, (2017), Spare part demand forecasting from installed base for consumer goods, <i>Computers &amp; Ind. Eng.</i>, 103, p. 201-215.</li> <li>6. Sha Zhu, Rommert Dekker, Willem van Jaarsveld, Renjie Rex Wang, Alex.J. Koning, (2017), An Improved Method for Forecasting Spare Parts Demand using Extreme Value Theory, <i>European Journal of Operational Research</i>, 261(1), p.169-181.</li> <li>7. Pince, C., Frenk, J.B.G. and Dekker, R., (2015), “ The Role of Contract Expirations in Service Parts Management”, <i>Prod. Oper. Mgmt.</i> 24(10), p.1580–1597. DOI: 10.1111/poms.12358</li> <li>8. Jaarsveld, W., Dollevoet, T. and Dekker, R. (2015), Spare parts inventory control for an aircraft component repair shop, <i>Omega</i>, 57, p. 217–229.</li> </ol>
<b>Requirements of candidate:</b>	<p>Background: MSc program with experience in quantitative logistics, especially with stochastic optimization methods, like Markov decision programming and reinforcement learning, next to good computer programming skills (Python, Java).</p> <p>Master's degree: Yes</p> <p><b>Erasmus School of Economics (Tinbergen Institute):</b>          IELTS: 7.0 (min 6.0 for all subs.)          TOEFL: 100 or 600 (paper)          GMAT: 680 or GRE-test: top 10% and Q score above 160</p>
<b>Supervisor information:</b>	<p><i>Prof. dr. ir. Rommert Dekker</i>  <a href="mailto:rdekker@ese.eur.nl">rdekker@ese.eur.nl</a></p> <p><a href="https://www.erim.eur.nl/people/rommert-dekker/">https://www.erim.eur.nl/people/rommert-dekker/</a></p> <p><b>Recent publications:</b></p> <ol style="list-style-type: none"> <li>1. Mulder, J. Van Jaarsveld, W. and Dekker, R. (2019), Simultaneous optimization of speed and buffer times with an application to liner shipping, <i>Transportation Science</i>, 53 (2), 365-382.</li> <li>2. Mulder, J. and R. Dekker (2019), Designing robust liner shipping schedules: optimizing recovery actions and buffer times, <i>European Journal of Operational Research</i>, 272(1), 132-146.</li> <li>3. Evelot Duijzer, Willem van Jaarsveld, Rommert Dekker, (2018), The benefits of combining early aspecific vaccination with later</li> </ol>

	<p>specific vaccination, <i>European Journal of Operational Research</i>, 271 p. 606–619.</p> <ol style="list-style-type: none"> <li>4. John Mallidis, Dimitrios Vlachos, Rommert Dekker and Lefteris Iakovou, (2018), An assessment of the Impact of Sulphur Limit Fuel Regulations on Supply Chain Network Design Decisions, <i>Annals of Operations Research</i>, (S).</li> <li>5. Engin Topan, Ayse Sena Eruguz, Weina Ma, Matthieu van der Heijden and Rommert Dekker, (2020), A review of Operational spare parts planning methods for service control towers, <i>European Journal of Operational Research</i>, 282 (2), p. 401-414.</li> <li>6. Sha Zhu, Willem van Jaarsveld and Rommert Dekker, Spare Parts Inventory Control based on Maintenance Planning (2020), <i>Reliability Engineering &amp; System Safety</i>, (193), 106600.</li> <li>7. Riessen, B., Mulder, J. van, Negenborn, R.R. and Dekker, Rommert, (2020), Revenue Management with Two Fare Classes in Synchronodal Container Transportation, to appear in <i>Flexible Services and Manufacturing Journal</i>,  <a href="https://doi.org/10.1007/s10696-020-09394-4">https://doi.org/10.1007/s10696-020-09394-4</a></li> <li>8. Thijs Schouten, Rommert Dekker and Mustafa Hekimoglu, Sena Eruguz, (2021), Optimal maintenance policies for time-varying costs: an application to windmill maintenance, to appear in <i>EJOR</i>.</li> </ol>
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**English requirements:** Please refer to Erasmus University China Center official website for your information [www.eur.nl/eucc](http://www.eur.nl/eucc)

*Erasmus University China Center -> CSC Scholarship -> "I am a prospective CSC PhD Candidate" -> Table 1*

Please note that each institute requires difference level of English, make sure to find the right institute. 2022 CSC-PhD programme information will be shared and updated soon!