

# Model Integrasi Jaringan Transportasi Laut Dalam Sistem Distribusi Barang di Wilayah Kepulauan = An Integration Model of Sea Transportation Network in Freight Distribution System in Archipelagic Region

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## Abstrak

<p>Sebagai Negara kepulauan, pemerintah Indonesia memberikan subsidi dan <em>public service obligation</em> <em>(PSO)</em> kepada kapal Tol Laut, Pelni dan Perintis untuk mendistribusikan barang ke pulau-pulau kecil. Ketiga jenis kapal tersebut secara independen mengelola waktu dan jaringan masing-masing. Akibatnya jaringan distribusi menjadi tidak efisien dan belum dapat secara maksimal menekan biaya angkut serta biaya subsidi-PSO. Penelitian ini bertujuan untuk mengembangkan dan menerapkan model <em>bi-level</em> dalam integrasi jaringan transportasi laut pada sistem distribusi barang di wilayah yang berciri kepulauan. Model <em>upper level</em> bertujuan meminimalkan jumlah kapal yang dioperasikan, sedangkan model <em>lower level</em> bertujuan menentukan rute yang memaksimalkan profit dalam distribusi barang yang melibatkan kapal Tol Laut, Pelni dan Perintis. Penggunaan genetik algoritma (GA) dalam pemecahan masalah dengan bentuk jaringan <em>milk run time windows (MRTW)</em> mampu mengakomodir variabel <em>uncertainty</em> berupa fluktuasi muatan dan tinggi gelombang yang belum dilakukan oleh penelitian sebelumnya. Hasil validasi model dengan tes empiris pada kasus di Indonesia menunjukkan bahwa model dapat memberikan nilai optimal dalam menyelesaikan masalah integrasi jaringan. Analisis sensitivitas menunjukkan bahwa jumlah kapal yang beroperasi, penerapan sistem cluster dan intervensi variabel <em>uncertainty</em> dalam penentuan rute kapal berpengaruh terhadap profit kotor. Penerapan sistem cluster mampu meningkatkan profit sebesar 36,5% dibandingkan tanpa <em>clustering</em>. Pengaturan rute kapal yang diintegrasikan secara <em>real time</em> dengan mempertimbangkan variabel fluktuasi muatan dan tinggi gelombang, memiliki konsekuensi bahwa profit kotor yang diterima mengalami penurunan sekitar 11,8% dibandingkan tanpa mempertimbangkan tinggi gelombang. Namun ada jaminan bahwa semua muatan akan terdistribusi sehingga masalah kelangkaan barang di wilayah terpencil, terluar dan perbatasan Indonesia mampu diatasi.</p><hr /><p>As an archipelagic country, Indonesian government gives subsidy and public service obligation (PSO) to Sea Tollway, Pelni and Pioneer vessels to distribute freights to small islands. These three types of vessel are independently managing their own time and network. As the result, the distribution network becomes inefficient and not optimal in suppressing transport cost and subsidy-PSO cost. The aim of this research is to develop and implement bi-level model in sea transport network integration on freight distribution system on archipelagic territory. Upper level model is intended to minimize the number of operated vessels, while lower level model is intended to determine the route that maximize the profit in freight distribution that involves Sea Tollway, Pelni and Pioneer vessels. The application of genetic algorithm (GA) in problem solving on milk run time windows (MRTW) network can accommodate the uncertainty variable, namely cargo fluctuation and wave height that has not been done by previous research. The result of model validation with empirical test on the case in Indonesia shows that the model can gives optimal value in solving the network integration problem. The sensitivity analysis shows that the number of

operating vessels, implementation of cluster system and the uncertainty variable intervention on the determination of vessel route affect the gross profit. The application of the cluster system can increasing profits by 36.5% compared without clustering. The management of vessel route should be integrated in real time by factoring the cargo fluctuation and wave height variable, with consequence that the received gross profit is decreasing by 11,8% when compared to the condition without the wave height consideration. However there is a guarantee that all cargo will be distributed so that the problem of scarcity of goods in remote area, outermost and Indonesian borders can be solved.</p>