GREEN AUTOMOTIVE MANUFACTURING LOGISTICS MODEL WITH REGIONAL JIT SUPPLIERS AND ASSEMBLY LOCATIONS

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ABSTRACT

Current automotive assembly methods rely heavily on centralized production facilities with local Just-In-Time (JIT) supplier networks. These current manufacturing models normally operate with a single manufacturing plant location, and rely on inefficient transportation of the final assembled product to distributor networks. By adopting modular vehicle assembly methods that rely on larger portions of the vehicle to be sourced from suppliers, and by establishing regional assembly facilities for final assembly, supply chain transportation efficiency can be optimized with an accompanying reduction in economic cost, emissions, and environmental impact.

INTRODUCTION

At the present time, it is generally accepted that vehicles are produced at a centralized production facility, from which the completed vehicles are distributed to regional distribution and preparation centers. After final preparations are performed at the distribution centers, the vehicles are then transported to distributor dealerships where they are sold to end users. This supply chain strategy relies heavily on the transportation of finished goods from a given central production facility, to the distribution centers, and then finally on to the various demand markets. While this approach has been in practice for decades, it is inefficient in the fact that the finished goods are very susceptible to damage during transport to their destination, and the manner in which the finished goods are being transported does not provide an overly desirable space versus cargo volume ratio. These factors create issues in the area of transportation related to economic and environmental cost, which is what this paper will focus on.

CURRENT PRACTICES - LOGISTICAL DRAWBACKS

With current practices, virtually all aspects of vehicle assembly are completed at a centralized production facility, with a complete and operational vehicle being the final good that leaves the factory. Following the widely adopted Toyota Production System (TPS) lean production model, significant portions of this process rely on local suppliers, most of which are JIT in nature.

Transportation of finished vehicles is horribly inefficient, as they cannot be stacked nor packed closely together, and the potential for damage is high, with road debris and the elements being constant factors. Unsupervised transportation by rail presents its own hazards with not being able to periodically confirm that the vehicle is properly secured and fastened down. Brand new vehicles must look absolutely flawless when they are presented for sale to customers, so all visible traces of transportation damage must be repaired prior to delivery to the dealerships. This inspection and repair is performed at the regional distribution centers – a significant hindrance to supply chain efficiency.

Currently, finished goods are only sent directly to dealerships that are located within approximately 300 miles of the assembly plant. All remaining vehicles are channeled through regional distribution centers. This indicates that this has already been determined by the manufacturers to be the generally accepted distance for economically feasible delivery.

Inventory holding costs are unnecessarily increased with the time that it takes to transport a vehicle at least twice, along with the time spent at each staging area or distribution center. With hundreds of thousands or millions of vehicles produced and sold each year, this can significantly add to operating and product costs.

REGIONAL ASSEMBLY MODEL - LOGISTIC BENEFITS

By modularizing the vehicle's design and assembly, and by shifting final assembly to regional assembly facilities, finished good transport could then be subject to a significantly shorter shipping distance from the final assembly point to the destination dealership. With properly located regional assembly facilities, the finished good shipping distance would generally average 25% to 50% of the distance when compared to the centralized production facility model.

This use of regionally clustered JIT suppliers (and/or shipment of the major components to the regional assembly centers) would eliminate the need for the inefficient and highly damage susceptible transportation of finished goods for 50% to 75% of the currently traveled delivery routes. This significant reduction in the opportunity for damage incurred during transit would proportionally reduce destination repair costs as well as reduce delays in delivery time due to transit damage repairs.

Shipping modular components to the regional assembly centers also results in the ability to utilize transportation space more efficiently, as the components can be loaded in a manner that is more densely packaged - as opposed to complete vehicles which require ample safety space and cannot be stacked. Holding costs for this inventory would be considerably less than with complete vehicles due to the more compact nature of containerizable goods.

COST COMPARISONS AND ENVIRONMENTAL BENEFITS

Environmental cost is rated using data from Victoria Transport Policy Institute studies whereby pollution has been summarized into dollar cost, based on all measurable detrimental costs from pollution, some of which include: future health costs, time costs, noise costs, land use impact cost, etc. By improving cargo space efficiency, environmental benefits are gained via reduced operating emissions. These emissions can be summarized as the societal cost for a given amount of emissions or pollution, and calculated on a per mile basis for any given mode of transportation. This can further be reduced to a given amount of pollution per unit of goods transported. Obviously, transporting more goods with the same level of emissions will decrease the amount of emissions produced for a given level of industrial output.

CONCLUSIONS

The utilization of modular vehicle production design with multiple regional assembly locations - versus one centralized location - allows for decreased transportation costs due to cargo space efficiency, and the minimization of transportation damage to finished goods. Further benefits are gained in the areas of

reduced pollution, emissions, and environmental impact due to improved overall transportation efficiency.

FUTURE RESEARCH

Future research will include the investigation of economic and environmental cost savings gained through the adoption of active recycling and reuse of the parts and components used for automotive production, as well as the use of electric power or alternative fuels for supplier and manufacturer local production transportation. Improved production efficiency and economic cost savings gained through the use of modularized vehicle design and assembly are other areas that will also receive further study. This future research, coupled with the logistic methods proposed in this study, can result in a desirable reduction in emissions and environmental impact along with long term sustainability in automotive production.

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