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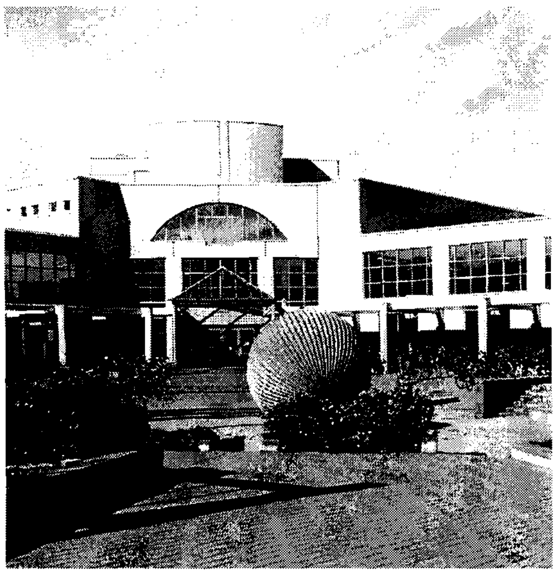

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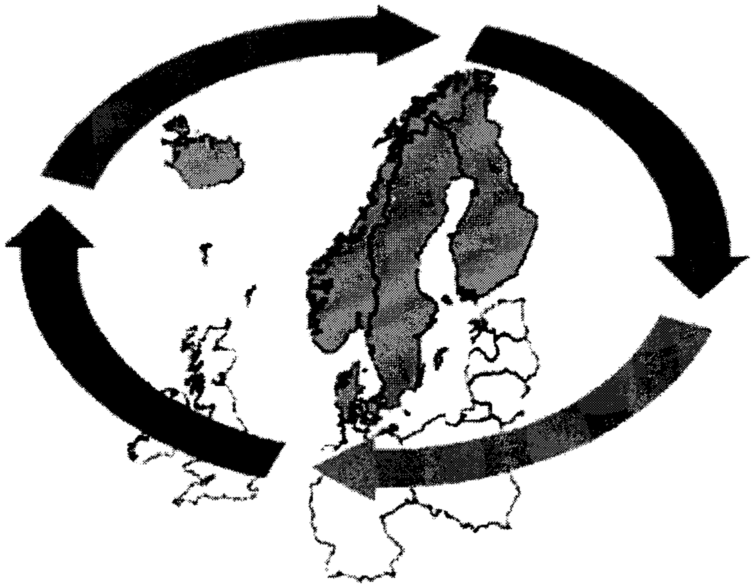

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4. E-Commerce and Logistics

5. Transportation

LOGISTICS CHAIN ANALYSIS: A BASIS FOR ANALYSING EFFICIENCY OF WHEAT-FLOUR TRANSPORT IN EGYPT

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ABSTRACT

In this paper, a methodological approach that is meant to compute and assess financial efficiency of transport activities within an own account company is developed. The applicability of this approach is demonstrated by using 98/99 data and information of Upper Egypt Wheat Milling Company. The approach involves several stages, the first of which is concerned with constructing logistics chains that simulate the process involved in wheat milling business in Egypt. These chains are used as the basis for identifying types of transported commodities, unique transport phases, trip origins and destinations of each of these phases as well as the transport modes and providers involved. This is followed by compiling and synthesizing, for each transport phase, a number of origin/destination matrices representing basic operational data and generic operational variables. In addition, similar size matrices are synthesized for transport costs, and transport revenues. Manipulations of the developed matrices are undertaken in an effort to compute financial efficiency for transport activities as well as to develop disaggregate route-based cost and revenue allocation models for transported wheat and flour. These are used in identifying those routes, where transport activity is profitable or alternatively not profitable.

Key Words: Logistics, Cost, Revenue, Models, Efficiency, Transport, Wheat, Flour, Egypt

1. INTRODUCTION

The wheat milling industry is one of the most important strategic industries in Egypt. Wheat cultivation in Egypt is not sufficient to meet the needs of domestic consumption. In 1998, locally cultivated wheat reached 1.13 million tons; while imported wheat reached 4.39 million tons, which means that Egypt is importing approximately 80% of its wheat needs. Currently four main companies are dominating the wheat milling industry with each concentrating its operation in a different geographical zone, thus covering the whole of Egypt. Upper Egypt Wheat Milling Company (UEWMC) covers the consumption of four main governorates, namely Sohag, Qena, Aswan and the Red Sea governorates. The population of this region is approximately 7.3 million capita, which represent approximately 12 % of Egypt's population. In 98/99 approximately 0.86 million tons of wheat was handled (i.e. transported, stored, milled, distributed) by this company which represent approximately 15.6% of wheat handled in Egypt.

This paper is concerned with developing a methodological approach that is meant to compute and assess the financial efficiency of transport activities within an own account company. The applicability of this approach is demonstrated by using 1998/99 relevant data and information of UEWMC. The proposed approach involves several stages, the first of which is concerned with constructing two logistics chains. Such chains are meant to show the activities and flow of raw materials and products for UEWMC. Activities considered in the logistics chains include procurement, transport, storage, and milling of wheat, as well as transport, storage, and distribution of flour to wholesale and retail customers. These chains describe the process involved in wheat milling business in Egypt. In this context, the significance of transport activities in the logistics chains of UEWMC is identified. The chains are used as the basis for identifying the types of transported commodities (i.e. imported and locally cultivated wheat, as well as ordinary and high grade flour), the unique transport phases, the trip origins and destinations of each of these phases as well as the transport modes and providers involved. This is then followed by compiling and synthesizing, for each of the identified transport phases, a number of origin/destination matrices representing basic operational data and generic operational variables such as tonnage transported, number of round trips, operated hours, traveled kilometers, and ton-kilometers. In addition, similar size matrices are synthesized for transport costs and revenues.

Manipulations of developed matrices are undertaken in an effort to compute financial efficiency of transport activities as well as to develop several cost and revenue allocation models. This is conducted on three levels. The first is an aggregate level that considers costs and revenues of all transport activities within the company. The second is a disaggtregate level that considers costs and revenues for each of the identified five unique transport phases. The third is a more disaggregate level that considers costs and revenues for each of the five transport phases on a route by route basis. In the third level, financial efficiencies are computed and cost and revenue models are calibrated for each cell of the developed matrices representing considered routes. These are used in identifying those routes, where transport activity is profitable and others where transport activity is not profitable. Such conclusion is particularly crucial in terms of assisting the management of the company in making decisions such as re-pricing transport services along certain routes, termination of operation or combining operation of other routes.

2. COST AND REVENUE MODELS: A BASIS FOR IMPROVING PROFITABILITY

The main objective of any company is to maximize its financial returns. Own account companies are those companies that posses a fleet of trucks serving the transport of required raw materials and produced finished goods by the company. Such transport sector within the company is meant to support the company in achieving more profits. If such sector is incurring losses, it might be better for the company to lease transport services from specialized transport service providers. A key indicator of the performance of the transport sector is to measure its financial efficiency. Financial efficiency is concerned with comparing financial outputs i.e. the transport operational revenues to financial inputs i.e. the transport operational costs. If the value of such indicator is less than unity, then the transport sector is financially deficient, i.e. not profitable. On the other hand, if the value is greater than unity, then the sector can be described as financially efficient, i.e. profitable. If the value of the indicator is equal to unity, this is known as the breakeven situation where operational revenues and costs are equal.

Once the financial performance of the sector is identified, other tools should be used in an effort to remedy or enhance such performance in the future. This paper advocates the view of building cost and revenue models to act as the basis for directing future actions aimed at improving the financial efficiency of transport activities. A comprehensive review of cost modelling approaches and their benefits was presented in Abbas and AbdAllah, 1999. One of these approaches, known as the average cost allocation model, is based on allocating costs of all resource requirements to a single system operating output such as travelled kilometers, operable hours, operable vehicles, patronage, or transported tonnage.

This paper proposes a hierarchical classification of cost allocation models, see figure 1, where four levels for building transport cost models are suggested. Similar principles and hierarchical levels can be applied for building transport revenue models. The first level in the proposed hierarchy is an aggregate level that considers the costs and revenues of all transport activities within the company, i.e. allocation of transport costs and revenues at the company level. Such aggregate models can be used in analysing the profitability of the transport sector as a whole within an own account company. Such analysis is meant to assist higher management in making strategic decisions as to whether the company ought to terminate its transport activities and rely on specialized transport providers or whether it is profitable for the company to pursue its transport activities using its own fleet.

The second proposed hierarchical level for constructing cost and revenue models is a disaggregate level that considers the costs and revenues for each of the unique commodities transported within the company activities, i.e. allocation of transport costs and revenues at commodity level. Such models can be used in analysing the profitability of transporting a particular commodity versus other commodities. Such analysis is meant to assist transport management in making strategic decisions as to whether the company ought to terminate its transport activities with regard to the movement of a particular commodity and rely on specialized transport providers or whether it is profitable for the company to pursue its activities in transporting such commodity using its own fleet. The third proposed hierarchical level for constructing cost and revenue models is a more disaggregate level that considers costs and revenues for each of the transported commodities on a route by route basis. These are used in identifying routes, where transport activity is profitable and others where transport activity is not profitable. Such conclusion is particularly crucial in terms of assisting the transport management in making decisions such as re-pricing its transport services along certain routes, termination of operation or combining operation of other routes.

Finally, the fourth proposed hierarchical level for constructing cost and revenue models is the most disaggregate level that considers the costs and revenues for each of the transported commodities on a route by route basis as well as on a vehicle type basis. Such models are particularly crucial in terms of assisting the transport management in making decisions such as re-allocation of certain types of vehicles to more suitable routes as well as to transporting more appropriate commodities. In addition, such models could help in the future procurement of types of vehicles that have proven to be operationally profitable as well as to disregard the procurement of other types of vehicles that have proven to be operationally non-profitable. The most appropriate operational variables that could be considered in the allocation of costs and revenues resulting from transportation of freight commodities are shown in figure 1. These include transported quantity, number of round trips, operated hours, travelled kilometers and ton-kilometers. Calibration of average cost and revenue models lies in computing unit transport cost and unit transport revenue. This is done by dividing the value of transport costs or revenues by the value of the selected operating variable, see figure 1.

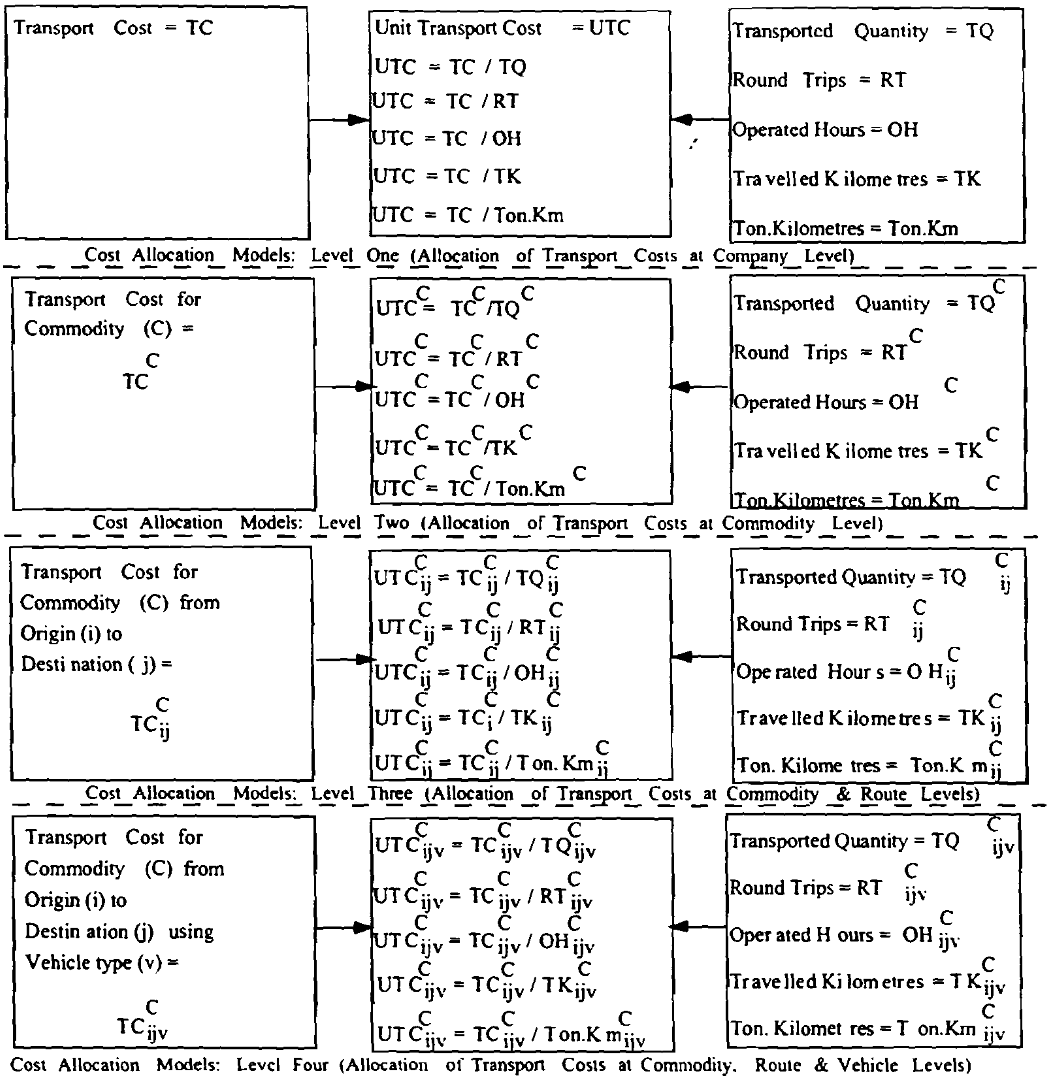


Figure 1: A Proposed Hierarchical Classification of Cost Models for Transport Activity Within an Own Account Company

This paper is concerned with developing a methodological approach that is meant to compute and assess the financial efficiency of transport activities within an own account company. The applicability of this approach is demonstrated by using 1998/99 relevant data and information of UEWMC. The proposed approach is depicted in figures 2, 5 and 6. It involves eight stages. In the following sections, the eight stages constituting the proposed approach are discussed in detail with reference to their applicability to UEWMC

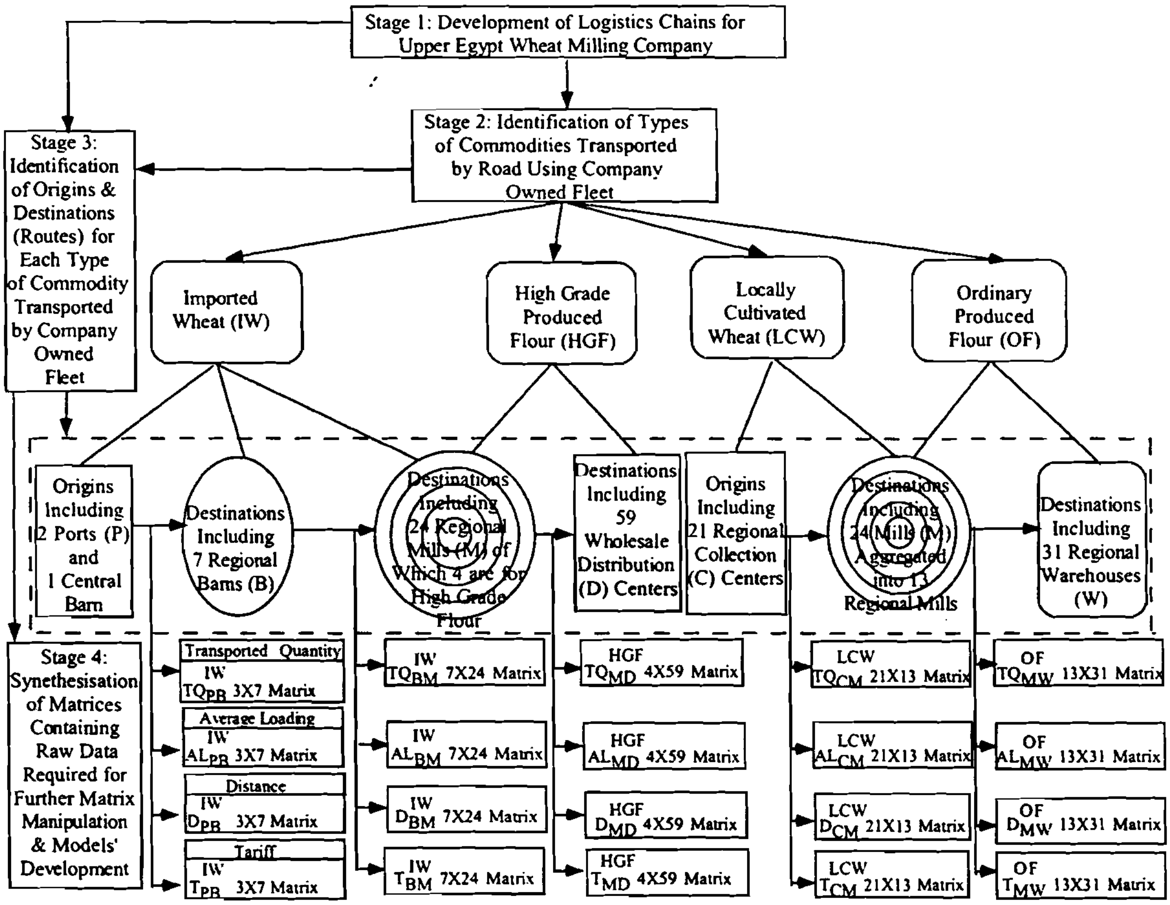


Figure 2: Development of Logistics Chains, Identification of Transported Commodities, Routes & Synethesisation of Base Data Matrices for UEWMC

3. CONSTRUCTING LOGISTICS CHAINS FOR UEWMC

More firms are adopting a supply chain management approach to guide business operations. In such arrangement, trading partners within the channel work together to leverage multi firm assets and competencies toward the identification and satisfaction of customers, see Bowersox, 1991. According to Trace, 2001, the logistical issues posed by bulk commodities may be explored more effectively using a system approach. In this context, the first stage in the proposed approach, see figure 2, is concerned with constructing logistics chains to represent and show activities and flow of raw materials and products for UEWMC. Activities considered in these chains include procurement, transport, storage, and milling of wheat, as well as transport, storage, and distribution of flour to wholesale & retail customers.

The first logistics chain, see figure 3, represents the flow of imported wheat, originating from exporting countries, transported by sea to main ports in Egypt, where the physical involvement of UEWMC starts in terms of custom clearance at ports and transportation of wheat from ports and central barn in Cairo to be stored in regional barns in upper Egypt. This is followed by wheat transportation from regional barns to regional mills. Together these stages constitute the inbound logistics chain of imported wheat. Four regional mills are involved in producing high-grade flour from imported wheat. High-grade flour is then transported to wholesale distribution centers located all over Egypt but particularly concentrated in upper Egypt. Together these stages constitute the outbound logistics chain of high-grade flour. The other logistics chain, see figure 4, represents the flow of locally cultivated wheat, its collection at regional collection centers, followed by its transport to the 24 regional mills, where ordinary flour is produced. Together these stages constitute the inbound logistics chain of locally cultivated wheat. More than twenty regional mills are involved in producing ordinary flour either from locally cultivated wheat or from imported wheat. A small portion of the ordinary flour is transported to seven regional automated bakeries owned by the company. The biggest share is transported to regional warehouses for storage and distribution. Wholesale customers are responsible for the transportation of ordinary flour from the company warehouses to their wholesale and retail outlets. Together these stages constitute the outbound logistics chain of ordinary flour.

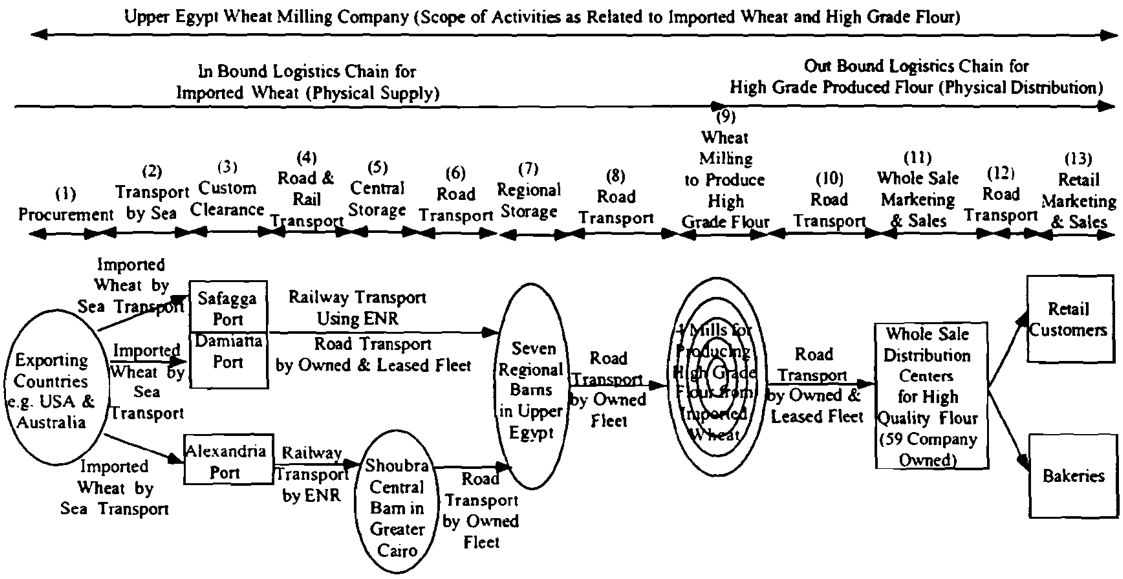
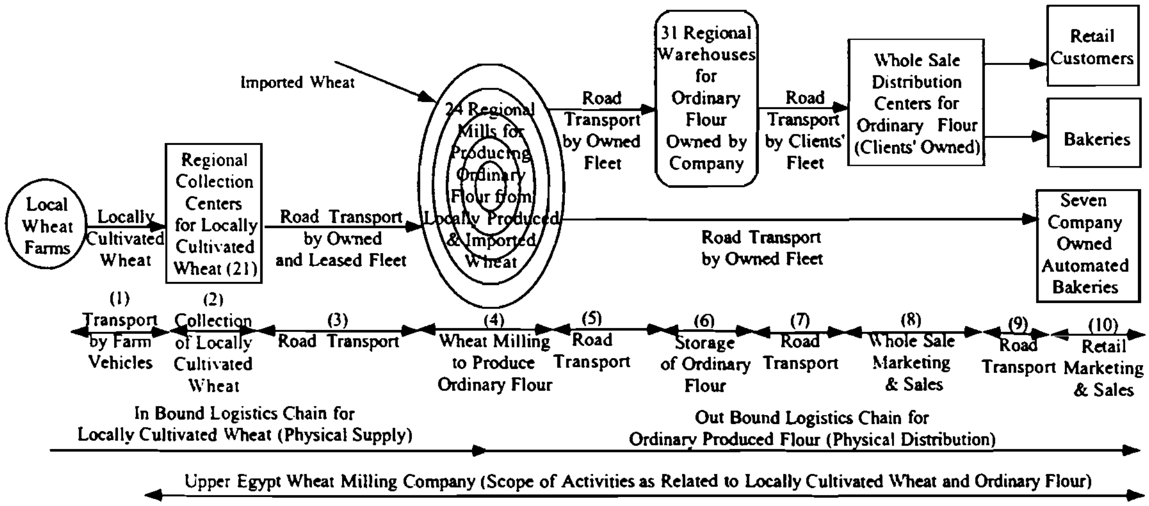


Figure 3: Logistics Chain for Imported Wheat & High Grade Flour Produced by UEWMC

Figure 4: Logistics Chain for Local Wheat & Ordinary Flour Produced by UEWMC



Limited research have tackled the issue of wheat transportation costs, see Bessler and Fuller, 2000 for a US example. This research is concerned with analysis of costs and revenues of transporting wheat and flour by UEWMC. It is worth mentioning that the logistics chains depicted in figures 3 and 4 can act as the basis for analysis of other major activities, within the company, such as warehousing and production. Also, it has to be noted that there is other transport activities shown in the figures, which are outside the scope of the research, namely:

- Transport of imported wheat by sea from exporting countries, such as USA and Australia, to Egyptian ports
- Transport of a portion of imported wheat from Egyptian ports to central and regional barns using railway services provided by Egypt National Railways (ENR).
- Road transport of imported wheat from Egyptian ports to regional barns using leased fleet.
- Road transport of a portion of high grade flour from regional mills to distribution centers using leased fleet
- Road transport of a portion of locally cultivated wheat from collection centers to regional mills using leased fleet.
- Road transport of ordinary flour from company's warehouses to wholesale distribution centers using clients' fleet.

Further research could consider the profitability of these transport activities as well as the effect of profitability on the selection of modes available for transporting wheat and flour.

3.1. COMMODITY AND ROUTE IDENTIFICATION

As shown in figure 2, the second stage in the proposed approach is concerned with identification of types of commodities transported by road using company owned fleet.

Examining the logistics chains depicted in figures 3 and 4, show that UEWMC is handling four types of commodities. The first two, namely imported and locally cultivated wheat, represent the raw materials required for the production (milling) process. The other two, namely high grade and ordinary flour, represent finished products to be distributed to customers. These four commodities are transported through several unique transport phases with different origins and destinations. This research concentrates on those transport phases where the company fleet is utilised to move commodities via the Egyptian road network. As shown in figure 2, the third stage in the proposed approach is concerned with identification of origins and destinations (routes) for each transport phase, where company fleet is involved. These include:

- Transport of imported wheat (IW) from Safagga and Damiatta ports (P) of as well as from the central barn in Cairo to seven regional barns (B) located in Upper Egypt. This produces 3X7 matrix i.e. 21 routes. In reality, transport activities took place along 13 routes only.
- Transport of imported wheat (IW) from seven regional barns (B) to 24 regional mills (M), producing a 7X24 matrix i.e. 168 routes. In reality, transport activities took place along 97 routes only.
- Transport of high-grade flour (HGF) from 4 regional mills (M) involved in producing high-grade flour to 59 distribution centers (D). This produces 4X59 matrix i.e. 236 routes. In reality, transport activities took place along 168 routes only.
- Transport of locally cultivated wheat (LCW) from 21 regional collection centers (C) to 24 regional mills (M), which are geographically aggregated into 13 zones. This produces 21X13 matrix i.e. 273 routes. In reality, transport activities took place along 50 routes only.
- Transport of ordinary flour (OF) from 21 regional mills (M) to 31 regional warehouses (W). Theoretically this produces a 21X31 matrix i.e. 651 routes. In reality, transport activities took place along 69 routes only.

4. COMPILATION AND SYNETHESISATION OF BASE DATA MATRICES TO PRODUCE OPERATING VARIABLES MATRICES

As shown in figure 2, the fourth stage in the proposed approach is concerned with compilation and synethesisation of raw data representing basic operational parameters for each of the five identified unique phases of transport. This data is drawn from company records in an effort to produce four matrices, namely transported quantity, average loading, distances and tariff matrices. Connotations for these matrices are also shown at the beginning of figure 5, where in stage five of the proposed approach, a process of matrix manipulation is conducted in an effort to produce matrices representing four key operating variables, namely round trips, operated hours, travelled kilometers and ton kilometers. The following represent mathematical formulations used to compute these variables for each transport phase.

$$RT_{ij}^{C} = TQ_{ij}^{C} / AL_{ij}^{C} \quad (1)$$

Where: *RT = Number of Round Trips*

TQ = Transported Quantity

AL = Average Loading

C = Type of Transported Commodity (IW, HGF, LCW, OF)

i = Trip Origins, i.e. i = P = 1,....3 for IW, or i = B = 1,....7 for IW, or i = M = 1,...4 for HGF, or i = C = 1,....21 for LCW, or i = M = 1,...21 for OF

j = Trip Destinations i.e. j = B = 1,....7 for IW, or j = M = 1,....24 for IW, or j = D = 1,...59 for HGF, or j = M = 1,....13 for LCW, or j = W = 1,...31 for OF

$$OH_{ij}^{C} = (((D_{ij}^{C} / AS_{ij}) * 2) + ALT^{C} + AUT^{C}) * RT_{ij}^{C} \quad (2)$$

Where: *OH = Operated Hours*

D = Distance between origin & destination (route distance)

AS = Average Speed

ALT = Average Loading Time

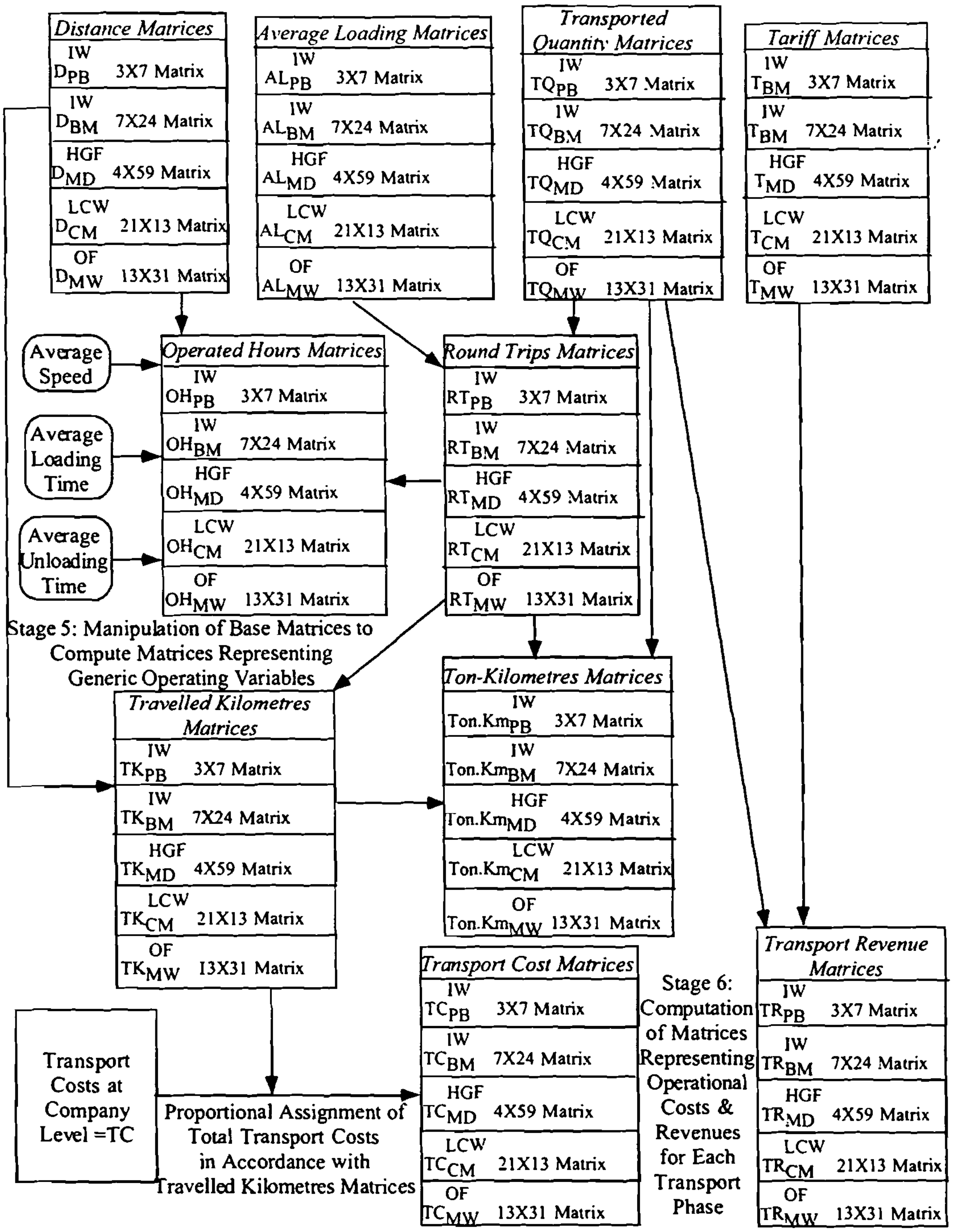
AUT = Average Unloading Time

$$TK_{ij}^{C} = RT_{ij}^{C} * D_{ij}^{C} * 2 \quad (3)$$ *Where: TK = Travelled Kilometers*

$$Ton.Km_{ij}^{C} = ((TQ_{ij}^{C} * TK_{ij}^{C}) / RT_{ij}^{C}) * ULF_{ij}^{C} \quad (4)$$

Where: Ton.Km = Number of Ton-Kilometers

ULF = Unloaded Factor i.e. a factor representing number of return trips where vehicles are empty. Values can range from 0.5 to 1.


Distance Matrices
IW DPB 3X7 Matrix
IW DBM 7X24 Matrix
HGF DMD 4X59 Matrix
LCW DCM 21X13 Matrix
OF DMW 13X31 Matrix
Average Loading Matrices
IW ALPB 3X7 Matrix
IW ALBM 7X24 Matrix
HGF ALMD 4X59 Matrix
LCW ALCM 21X13 Matrix
OF ALMW 13X31 Matrix
Transported Quantity Matrices
IW TQPB 3X7 Matrix
IW TQBM 7X24 Matrix
HGF TQMD 4X59 Matrix
LCW TQCM 21X13 Matrix
OF TQMW 13X31 Matrix
Tariff Matrices
IW TBM 3X7 Matrix
IW TBM 7X24 Matrix
HGF TMD 4X59 Matrix
LCW TCM 21X13 Matrix
OF TMW 13X31 Matrix
Average Speed
Average Loading Time
Average Unloading Time
Operated Hours Matrices
IW OHPB 3X7 Matrix
IW OHBM 7X24 Matrix
HGF OHMD 4X59 Matrix
LCW OHCM 21X13 Matrix
OF OHMW 13X31 Matrix
Round Trips Matrices
IW RTPB 3X7 Matrix
IW RTBM 7X24 Matrix
HGF RTMD 4X59 Matrix
LCW RTCM 21X13 Matrix
OF RTMW 13X31 Matrix
Stage 5: Manipulation of Base Matrices to Compute Matrices Representing Generic Operating Variables
Travelled Kilometres Matrices
IW TKPB 3X7 Matrix
IW TKBM 7X24 Matrix
HGF TKMD 4X59 Matrix
LCW TKCM 21X13 Matrix
OF TKMW 13X31 Matrix
Ton-Kilometres Matrices
IW Ton.KmPB 3X7 Matrix
IW Ton.KmBM 7X24 Matrix
HGF Ton.KmMD 4X59 Matrix
LCW Ton.KmCM 21X13 Matrix
OF Ton.KmMW 13X31 Matrix
Transport Costs at Company Level =TC
Proportional Assignment of Total Transport Costs in Accordance with Travelled Kilometres Matrices
Transport Cost Matrices
IW TCPB 3X7 Matrix
IW TCBM 7X24 Matrix
HGF TCMD 4X59 Matrix
LCW TCCM 21X13 Matrix
OF TCMW 13X31 Matrix
Stage 6: Computation of Matrices Representing Operational Costs & Revenues for Each Transport Phase
Transport Revenue Matrices
IW TRPB 3X7 Matrix
IW TRBM 7X24 Matrix
HGF TRMD 4X59 Matrix
LCW TRCM 21X13 Matrix
OF TRMW 13X31 Matrix

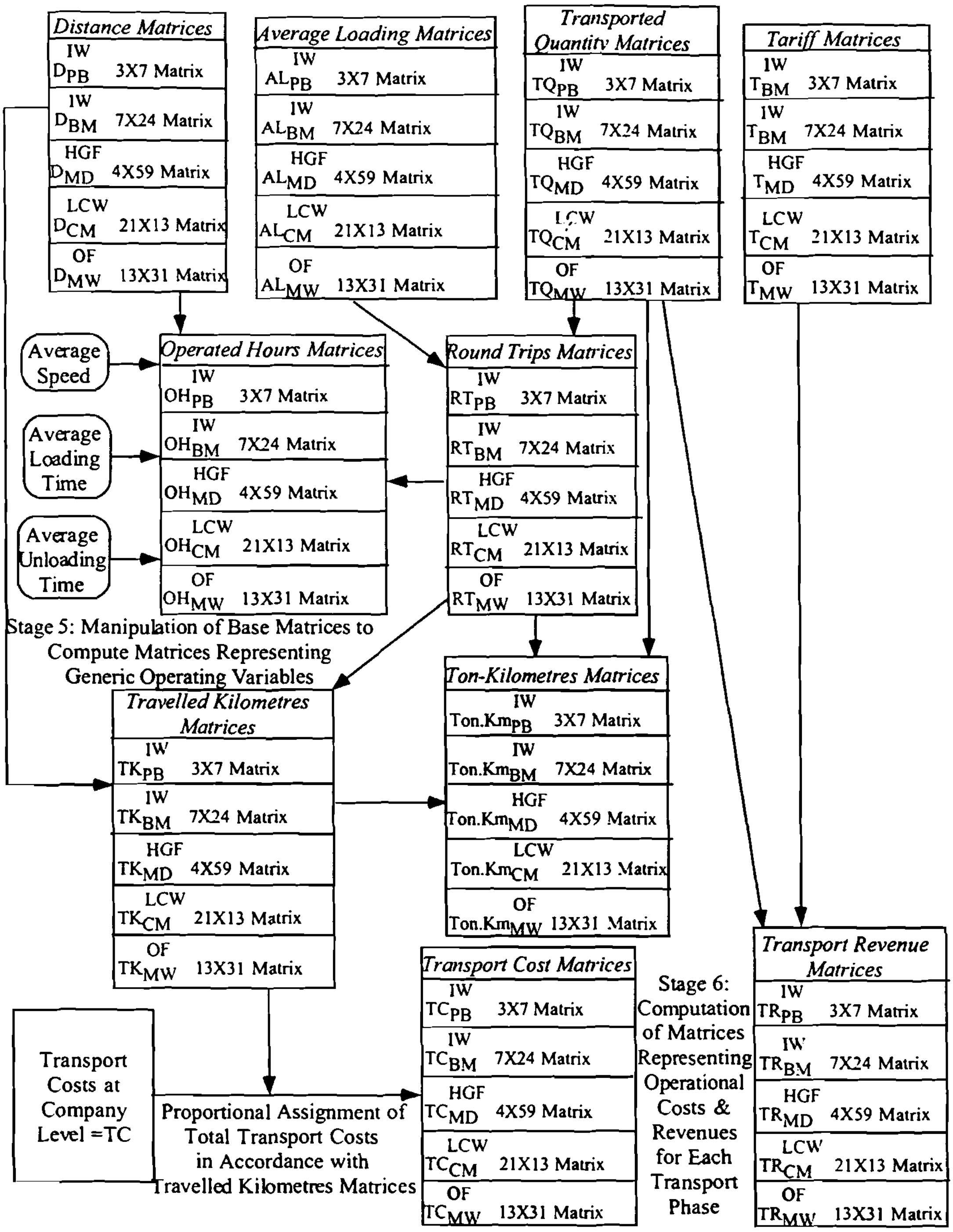


Figure 5: Compilation and Synethesisation of Base Data Matrices to Produce Operating Variables Matrices as well as Operating Cost and Operating Revenue Matrices

Values resulting from matrix summation for each of the operational variables representing the five transport phases are displayed in table 1. The table shows that the largest quantity being transported by the company fleet is the imported wheat from the seven regional barns to the 24 regional mills. The table also shows that this in turn has an effect in increasing the number of round trips and hence operated hours for this phase of transportation activities. However, this is not the case for ton-kilometers which is the highest in the case of transporting imported wheat from the 2 sea ports and the central barn in Cairo to the seven regional barns. This can be logically explained by noting that the average distance for this type of trip is around 615 kilometers, versus 93 kilometers for the average trip between regional barns and regional mills. Also more consolidation of loads, i.e. 33 ton/trip versus 15 ton/trip on average, occurs for this phase of transport activity, where it is costly to leave imported wheat stored at ports. Such long distances and consolidation of loads lead to a lesser number of trips. It is well known that it is only in this phase that the company leases transport services from transport providers so as to be able to meet the peak demand of unloading ships coming to ports with imported wheat. The table also shows the relatively insignificance of the phase where locally cultivated wheat is transported from collection centers to regional mills.

Table 1: Matrix Summation of Operational Variables for the Five Main Transport Phases Operated by UEWMC Owned Fleet

			Operational Variables for Transport Phases			
Commodity (C)	Origin (i)	Destination (j)	Transported Quantity ($\Sigma_{ij}TQ_{ij}^{C}$)	Round Trips ($\Sigma_{ij}RT_{ij}^{C}$)	Operated Hours ($\Sigma_{ij}OH_{ij}^{C}$)	Ton-Kilometers ($\Sigma_{ij}Ton.Km_{ij}^{C}$)
Imported Wheat (IW)	2 Ports & Central Barn	7 Regional Barns	151370 (11.9%)	4599 (6.31%)	70180 (18.48%)	46177152 (26.76%)
Imported Wheat (IW)	7 Regional Barns	24 Regional Mills	691343 (54.34%)	47250 (64.8%)	120552 (31.74%)	33599166 (19.47%)
High Grade Flour (HGF)	4 Regional Mills	59 Distribution Centers	113433 (8.92%)	4603 (6.31%)	83412 (21.96%)	63191419 (36.62%)
Locally Cultivated Wheat (LCW)	21 Collection Centers	24 Regional Mills*	12822 (1.01%)	621 (0.85%)	10594 (2.79%)	6063239 (3.51%)
Ordinary Flour (OF)	21 Regional Mills**	39 Regional Warehouses	303316 (23.84%)	15845 (21.73%)	95036 (25.02%)	23506191 (13.62%)
		Total	1272284	72918	379774	172537167

(*) The 24 mills are aggregated in accordance with their regional locations into 13 locations

(**) As previously stated, only 21 out of 24 mills produced ordinary flour

5. COMPUTATION OF MATRICES REPRESENTING OPERATIONAL COSTS AND REVENUES FOR EACH TRANSPORT PHASE

As shown in figure 5, the sixth stage of the proposed approach is concerned with the computation of matrices representing operational costs and revenues for the five identified transport phases. On reviewing company records, it was found that there are no separate data on transport cost for each of the five transport phases. Transport costs is aggregated for all of the transport activities conducted by the company and are as shown in table 2.

Transport Cost Item	Cost Resulting From Operating Company Owned Fleet
Staff Costs	3976524 L.E.* (26.31%)
Fuel & Other Petroleum Requirements	2268000 L.E. (15%)
Spare Parts	3055370 L.E. (20.21%)
Maintenance	164283 L.E. (1.09%)
Licensing, Taxes & Fees	145177 L.E. (0.96%)
Depreciation	2316790 L.E. (15.33%)
Other	3189024 L.E. (21.1%)
Total	15115168 L.E.

(*) Currently 1US$ = 5.3 Egyptian Pounds (denoted as L.E.) Source: 98/99 Company Records

In order to compute transport costs for each of the five transport phases as well as for each of the considered routes, a proportional assignment of total transport costs was conducted. Travelled kilometers was selected as the basis for conducting such assignment as it is thought as the most significant operational variable affecting operation costs and revenues, see figure 5. The mathematical formulation for this proportional assignment is as follows:

$$TC_{ij}^{C} = TC^{*}[TK_{ij}^{C} / (\Sigma_{ij} TK_{PB}^{IW} + \Sigma_{ij} TK_{BM}^{IW} + \Sigma_{ij} TK_{MD}^{HGF} + \Sigma_{ij} TK_{CM}^{LCW} + \Sigma_{ij} TK_{MW}^{OF})] \quad (5)$$

Values of computed transport costs for each of the five transport phases are depicted in table 3. On the other hand, transport revenue for each transport phase is computed by multiplying the matrix representing transported quantities by the unit tariff matrix, see figure 5. The unit tariffs are determined in accordance with the type of transported commodity as well as with the journey distances. Such tariffs are decided and paid to the company by a government agency, holding the responsibility for securing strategic agriculture products for Egypt. The formulation for such matrix manipulation can take the following form:

$$TR_{ij}^{C} = TQ_{ij}^{C} * T_{ij}^{C} \quad (6)$$

Values of computed transport revenues for each of the five transport phases are shown in table 3. In addition, the table displays the computation of financial efficiency as an indicator of the profitability/non-profitability of all transport activities conducted by the company as well as for each of the five transport phases. The table shows that transport activities for the company is generally on the profitable side, where financial efficiency reached 1.19 i.e. achieving a 19% profitability. However, this is not a very high profitability value. Looking at each transport phase, it became clear that there are two phases which are incurring losses, the first is concerned with transporting high grade flour from regional mills to distribution centers scattered all over Egypt. The other phase, proving non-profitable, is concerned with transporting locally cultivated wheat from regional collection centers to regional mills. On the other hand, the table shows the high profitability achieved by the fifth transport phase, which involves moving ordinary flour from regional mills to regional warehouses.

Table 3: Computation of Financial Efficiency for Each Transport Phase Based on Transport Costs and Revenues

Commodity (C)	Origin (i)	Destination (j)	Transport Costs (TC^C)	Travelled Kilometers ($\Sigma_{ij}TK_{ij}^C$)	Transport Costs* ($\Sigma_{ij}TC_{ij}^C$)	Transport Revenue ($\Sigma_{ij}TR_{ij}^C$)	Financial Efficiency (FE^C)
Imported Wheat	2 Ports & Central Barn	7 Regional Barns	Not Recorded	2830857 (22.09%)	3339470 (22.09%)	4891524 (27.15%)	1.46
Imported Wheat	7 Regional Barns	24 Regional Mills	Not Recorded	4398119 (34.33%)	5188318 (34.33%)	5897134 (32.73%)	1.14
High Grade Flour	4 Regional Mills	59 Distribut. Centers	Not Recorded	3347374 (26.12%)	3948789 (26.12%)	3153707 (17.50%)	0.8
Locally Cultivated Wheat	21 Collection Centers	24 Regional Mills	Not Recorded	337455 (2.63%)	398085 (2.63%)	354201 (1.97%)	0.89
Ordinary Flour	21 Regional Mills	39 Regional Warehouses	Not Recorded	1899269 (14.82%)	2240506 (14.82%)	3721946 (20.66%)	1.66
		Total	15115168	12813074	15115168	18018512	1.19

Based on the previous analysis, several conclusions can be drawn. First, it is wise for the company to sustain and develop operation of its transport sector, as this sector proved to be profitable. On the other hand, the company should look seriously at all of its transport phases and particularly at the third and fourth transport phases, which proved to be unprofitable. In this context, and in accordance with figure 1, the research develops in tables 4 and 5 cost and revenue models for all of the transport activities operated by the company owned fleet as well as separate cost and revenue models for each of the five identified transport phases.

The calibration factors i.e. the unit cost and unit revenue factors of these models are examined. For the third transport phase to breakeven either an average transport cost reduction from 34.81 L.E./transported ton to 27.8 L.E./transported ton (i.e. a 20% reduction) should be targeted. Alternatively, an average increase in paid transport tariff from 27.8 L.E./transported ton to 34.81 L.E./transported ton (i.e. a 25% increase) can also achieve a breakeven condition. The same analysis can apply for the fourth transport phase, where for this phase to breakeven either an average transport cost reduction from 31.05 L.E./transported ton to 27.62 L.E./transported ton (i.e. an 11% reduction) should be targeted. Alternatively, an average increase in paid transport tariff from 27.62 L.E./transported ton to 31.05 L.E./transported ton (i.e. a 12.4% increase) can achieve the same results

6. FINANCIAL EFFICIENCY, COST AND REVENUE MODELS FOR TRANSPORT ACTIVITIES DISAGGREGATED BY COMMODITY & ROUTE

As shown in figure 6, the seventh stage of the proposed approach is concerned with the computation of financial efficiency for transport activities disaggregated by commodity type, i.e. for each transport phase as well as being disaggregated by each route joining a particular origin with a particular destination. Computation of this indicator demonstrates that the most two successful transport phases in terms of the number of profitable routes are the first and fifth phases, see table 6. The table shows that out of 13 routes utilised by the first transport phase, 9 are profitable, i.e. 69%, while out of 69 routes utilised by the fifth transport phase, 46 are profitable, i.e. 67%. Of course the transport department within the company should be concentrating on identifying all those routes where transport operation is not profitable and particularly for third and fourth phase. Once such routes are identified, specific cost and revenue models representing transport operation along them are calibrated, see Aly, 2000 for details of this analysis. For demonstration purposes, detailed analysis for the first transport phase is presented throughout tables 7, 8 & 9. Despite that this phase is the second most profitable, it was selected due to space limitations, which does not permit displaying the large matrices presenting other transport phases. However, analysis for this phase is suffice to act as a prototype example. As shown in table 7, four routes are identified as being unprofitable, i.e. financial efficiency of transport operation is less than 1. For all routes and particularly those four routes, cost and revenue models are developed and shown in tables 8 & 9. Looking at such models, one can deduce that for the four unprofitable routes to breakeven, either the unit transport costs should be reduced to reach the unit transport revenue or vice versa i.e. the tariff of transportation for these routes should be increased to breakeven with the unit transport costs. Another alternative for management is to completely drop operation of such routes using their own fleet and to lease such services from specialised transport providers. A computer model assisting in making such decisions is reported by Min, 1998.

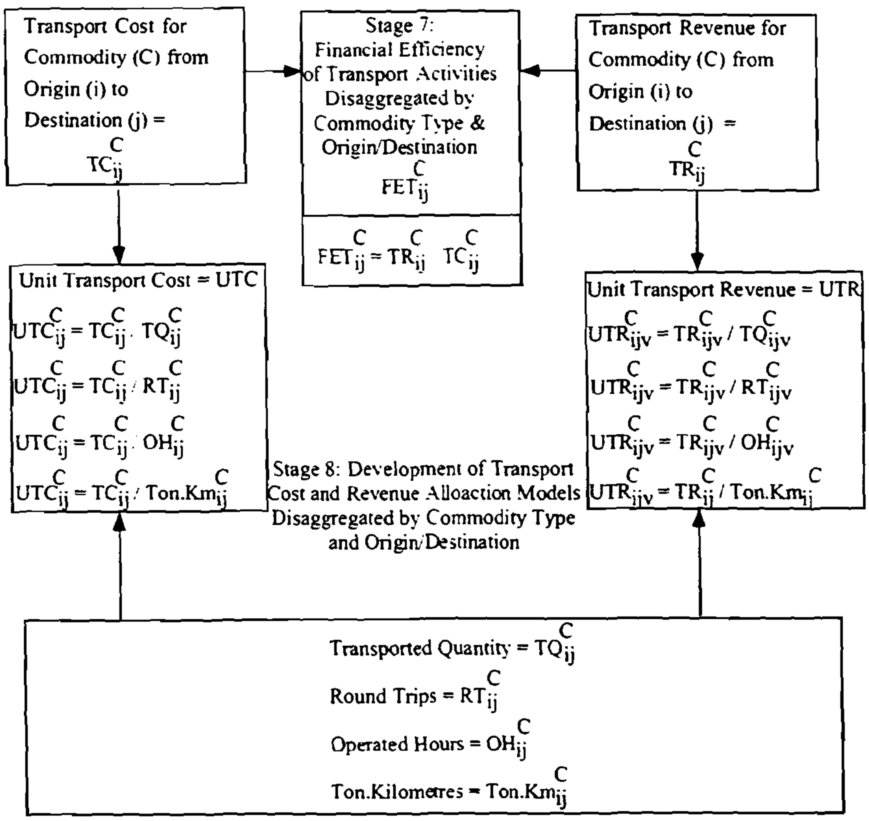


Figure 6: Computation of Financial Efficiency & Calibration of Cost and Revenue Models for Transport Activities Disaggregated by Commodity & Origin/Destination

7. CONCLUSIONS

This paper was concerned with developing a methodological approach to compute and assess financial efficiency of transport activities within an own account company. The applicability of this approach, which involves eight stages, was demonstrated by using 98/99 data and information of UEWMC. The first stage in the proposed approach was concerned with constructing two logistics chains to represent and show the activities and flow of raw materials and products for the company. Such chains act as the basis for computing financial efficiency and developing cost and revenue models for transport activities operated by the company owned fleet. The research shows how financial efficiency for five distinct transport phases was computed. The largest quantity being transported by the company fleet is imported wheat from barns to mills. This is followed by ordinary flour from mills to warehouses. These two transport phases are completely operated by company fleet. In terms of financial efficiency, both phases proved to be profitable. Transport activities for the company is generally on the profitable side, where the financial efficiency reached 1.19. However, this is not a very high profitability. It became clear that two other phases are incurring losses, the first is the phase concerned with transporting high grade flour from mills to distribution centers scattered all over Egypt. The other non-profitable phase is concerned with transporting locally cultivated wheat from collection centers to mills.

Based on such analysis, it is wise for the company to sustain and develop operation of its transport sector, as this sector proved to be profitable. On the other hand, the company should look seriously at all of its transport phases and particularly at the third and fourth phases, which proved to be unprofitable.

Table 4: Cost Allocation Models for Phases of Transporting Main Commodities by Fleet Owned by Upper Egypt Milling Company

			Four Operating Outputs Taken as Basis for Allocation of Transport Costs			
Commodity	Origin	Destination	Transported Quantity (TQ)	Round Trips (RT)	Operated Hours (OH)	Ton-Kilometers (Ton.Km)
Imported Wheat (IW)	2 Ports & Central Barn	7 Regional Barns	$TC^{IW} = 22.06*TQ^{IW}$	$TC^{IW} = 726.13*RT^{IW}$	$TC^{IW} = 47.58*OH^{IW}$	$TC^{IW} = 0.072*Ton.Km^{IW}$
Imported Wheat (IW)	7 Regional Barns	24 Regional Mills	$TC^{IW} = 7.50*TQ^{IW}$	$TC^{IW} = 109.81*RT^{IW}$	$TC^{IW} = 43.04*OH^{IW}$	$TC^{IW} = 0.154*Ton.Km^{IW}$
High Grade Flour (HGF)	4 Regional Mills	59 Distribution Centers	$TC^{HGF} = 34.81*TQ^{HGF}$	$TC^{HGF} = 857.87*RT^{HGF}$	$TC^{HGF} = 47.34*OH^{HGF}$	$TC^{HGF} = 0.062*Ton.Km^{HGF}$
Locally Cultivated Wheat (LCW)	21 Collection Centers	24 Regional Mills	$TC^{LCW} = 31.05*TQ^{LCW}$	$TC^{LCW} = 641.04*RT^{LCW}$	$TC^{LCW} = 37.58*OH^{LCW}$	$TC^{LCW} = 0.066*Ton.Km^{LCW}$
Ordinary Flour (OF)	21 Regional Mills	39 Regional Warehouses	$TC^{OF} = 7.39*TQ^{OF}$	$TC^{OF} = 141.40*RT^{OF}$	$TC^{OF} = 23.58*OH^{OF}$	$TC^{OF} = 0.095*Ton.Km^{OF}$
All			$TC^{All} = 11.88*TQ^{All}$	$TC^{All} = 207.29*RT^{All}$	$TC^{All} = 39.8*OH^{All}$	$TC^{All} = 0.088*Ton.Km^{All}$

Table 5: Revenue Allocation Models for Phases of Transporting Main Commodities by Fleet Owned by Upper Egypt Milling Company

			Four Operating Outputs Taken as Basis for Allocation of Transport Revenues			
Commodity	Origin	Destination	Transported Quantity (TQ)	Round Trips (RT)	Operated Hours (OH)	Ton-Kilometers (Ton.Km)
Imported Wheat (IW)	2 Ports & Central Barn	7 Regional Barns	$TR^{IW} = 32.32*TQ^{IW}$	$TR^{IW} = 1063.61*RT^{IW}$	$TR^{IW} = 69.70*OH^{IW}$	$TR^{IW} = 0.106*Ton.Km^{IW}$
Imported Wheat (IW)	7 Regional Barns	24 Regional Mills	$TR^{IW} = 8.53*TQ^{IW}$	$TR^{IW} = 124.81*RT^{IW}$	$TR^{IW} = 48.92*OH^{IW}$	$TR^{IW} = 0.176*Ton.Km^{IW}$
High Grade Flour (HGF)	4 Regional Mills	59 Distribution Centers	$TR^{HGF} = 27.80*TQ^{HGF}$	$TR^{HGF} = 685.14*RT^{HGF}$	$TR^{HGF} = 37.81*OH^{HGF}$	$TR^{HGF} = 0.050*Ton.Km^{HGF}$
Locally Cultivated Wheat (LCW)	21 Collection Centers	24 Regional Mills	$TR^{LCW} = 27.62*TQ^{LCW}$	$TR^{LCW} = 570.37*RT^{LCW}$	$TR^{LCW} = 33.43*OH^{LCW}$	$TR^{LCW} = 0.058*Ton.Km^{LCW}$
Ordinary Flour (OF)	21 Regional Mills	39 Regional Warehouses	$TR^{OF} = 12.27*TQ^{OF}$	$TR^{OF} = 234.90*RT^{OF}$	$TR^{OF} = 39.16*OH^{OF}$	$TR^{OF} = 0.158*Ton.Km^{OF}$
All			$TR^{All} = 14.16*TQ^{All}$	$TR^{All} = 247.11*RT^{All}$	$TR^{All} = 47.45*OH^{All}$	$TR^{All} = 0.104*Ton.Km^{All}$

Table 6: Computation of Financial Efficiency for Routes Utilised by Each Transport Phase Based on Transport Costs and Revenues Matrices

Commodity (C)	Origin (i)	Destination (j)	Financial Efficiency ≥ 1	Financial Efficiency < 1
Imported Wheat	2 Ports & Central Barn	7 Regional Barns	9 routes (69%)	4 routes (31%)
Imported Wheat	7 Regional Barns	24 Regional Mills	34 routes (35%)	63 routes (65%)
High Grade Flour	4 Regional Mills	59 Distribution Centers	65 routes (39%)	103 routes (61%)
Locally Cultivated Wheat	21 Collection Centers	24 Regional Mills*	25 routes (50%)	25 routes (50%)
Ordinary Flour	21 Regional Mills*	39 Regional Warehouses	46 routes (67%)	23 routes (33%)
		Total	179 (45%)	218 (55%)

Table 7: Computation of Financial Efficiency for Routes Utilised by First Transport Phase (i.e. Imported Wheat from Ports and Central Barn to Regional Barns) Based on Origin/Destination Transport Costs and Revenues

Origin/Destination	Sohag Barn	Beleeena Barn	Qena Barn	Qous Barn	Asna Barn	Edfo Barn	Aswan Barn
Safagaa Port	1.7	1.36	1.69	1.79	1.28	1.38	1.05
Damiatta Port	1.14	0.95	Not Applicable	0.99	Not Applicable	Not Applicable	1.02
Central Barn in Cairo	0.86	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	0.92

Table 8: Cost Allocation Models for Routes Utilised by First Transport Phase (Imported Wheat from Ports and Central Barn to Regional Barns)

	Sohag Barn	Beleeena Barn	Qena Barn	Qous Barn	Asna Barn	Edfo Barn	Aswan Barn
Safagaa Port	$TC^{IW} = 20*TQ^{IW}$	$TC^{IW} = 22*TQ^{IW}$	$TC^{IW} = 13*TQ^{IW}$	$TC^{IW} = 14*TQ^{IW}$	$TC^{IW} = 25*TQ^{IW}$	$TC^{IW} = 26*TQ^{IW}$	$TC^{IW} = 43*TQ^{IW}$
Damiatta Port	$TC^{IW} = 51*TQ^{IW}$	$TC^{IW} = 65*TQ^{IW}$	Not Applicable	$TC^{IW} = 73*TQ^{IW}$	Not Applicable	Not Applicable	$TC^{IW} = 89*TQ^{IW}$
Central Barn in Cairo	$TC^{IW} = 42*TQ^{IW}$	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	$TC^{IW} = 71*TQ^{IW}$

Table 9: Revenue Allocation Models for Routes Utilised by First Transport Phase (Imported Wheat from Ports and Central Barn to Regional Barns)

	Sohag Barn	Beleeena Barn	Qena Barn	Qous Barn	Asna Barn	Edfo Barn	Aswan Barn
Safagaa Port	$TR^{IW} = 34*TQ^{IW}$	$TR^{IW} = 30*TQ^{IW}$	$TR^{IW} = 22*TQ^{IW}$	$TR^{IW} = 25*TQ^{IW}$	$TR^{IW} = 32*TQ^{IW}$	$TR^{IW} = 36*TQ^{IW}$	$TR^{IW} = 45*TQ^{IW}$
Damiatta Port	$TR^{IW} = 58*TQ^{IW}$	$TR^{IW} = 62*TQ^{IW}$	Not Applicable	$TR^{IW} = 72*TQ^{IW}$	Not Applicable	Not Applicable	$TR^{IW} = 91*TQ^{IW}$
Central Barn in Cairo	$TR^{IW} = 36*TQ^{IW}$	Not Applicable	Not Applicable	Not Applicable	Not Applicable	Not Applicable	$TR^{IW} = 65*TQ^{IW}$

The transport department within the company should be concentrating on identifying all those routes where transport operation is not profitable and particularly for the third and fourth phase. Once such routes are identified, it is advisable to calibrate specific cost and revenue models representing transport operation along these routes. Looking at such models, one can deduce that for the unprofitable routes to breakeven, either the unit transport costs should be reduced to reach the unit transport revenue or vice versa i.e. the tariff of transportation services along these routes should be increased to breakeven with the unit transport costs. Another alternative for management is to completely drop operation of such routes using their own fleet and to lease such services from specialised transport providers. To demonstrate such analysis, the research developed disaggregate route based cost and revenue models for transporting imported wheat from ports to regional barns. These are meant to assist in predicting and showing the relative magnitude of expected changes in the cost and revenue expected of transport activities. The development of such models is thought to contribute in raising the profitability consciousness with an ultimate benefit of reducing costs and increasing revenue and hence achieving efficiency gains. After deregulation, the company is no more a part of the social responsibility and the flour subsidy provided by the government to the population in Egypt. In this context, further future research should be looking at the other transport phases not covered in this paper. The question for future research is what is the most cost efficient/highest revenue option for the whole transport activities within the logistics chains of UEWMC. In addition, efforts for optimally locating distribution centers and warehouses to reduce transport costs for the company should be developed, see Das, 1997 and Nozick & Turnquist, 1998 for research on developing analytical tools to assist in such decisions.

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