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MODEL:
! A Novel Fuzzy-Stochastic Multi-Objective Fleet Planning Model in An Intermodal Transportation Network
SETS:
! Sets and Indices;
ORIGINS/1..3/:V_IE0,ST_I0,V_IT0; !Ports in Turkey;
RORO_TERMINALS/1..4/:V_J0;       !Ports in Europe;
TRAIN_TERMINALS/1..6/:V_K0;      !Railway stations in Europe;
DESTINATIONS/1..49/:ST_L0,V_LT0,V_LE0;   !Order Countries in Europe;
PERIODS/1..12/:Aylik_Maliyet,Aylik_Sure,Aylik_CO2,ZM1,ZM2,ZM3,ZM4,ZM5,ZM6,ZM7,ZM8,ZM9,ZT1,ZT2,ZT3,ZT4,ZT5,ZE1
,ZE2,ZE3,ZE4,ZE5; !Annual period devided into months;
RESULTS/1..1/:ZCOST,ZPES,ZMOS,ZOPT,ZENVIRONMENT,ZEPES,ZEMOS,ZEOPT,ZTIME,ZTPES,ZTMOS,ZTOPT;
! Amount of transported freight and mode tha used
SHIPPMENT_IMP(ORIGINS,DESTINATIONS,PERIODS):X_IMP,DE_IMP,C_SP_IMP,SP_IMP,DE_IMP_MU,DE_IMP_STD,C_SP_IMPP,C_SP_
IMPO;
SHIPPMENT_EXP(DESTINATIONS,ORIGINS,PERIODS):X_EXP,DE_EXP,C_SP_EXP,SP_EXP,DE_EXP_MU,DE_EXP_STD,C_SP_EXPP,C_SP_
EXPO;
!-------------------------------------------------------------------------------;
! Marine transportation network and transit times;
MARILINK1(ORIGINS,RORO_TERMINALS)/1 1, 1 2, 1 4, 2 2, 2 3, 3 2/:TT_IJ,TT_IJP,TT_IJO;
MARILINK2(RORO_TERMINALS,ORIGINS)/1 1, 2 1, 4 1, 2 2, 3 2, 2 3/:TT_JI,TT_JIP,TT_JIO;
! Combined marine & road transportation variables;
SEMI_INTERMODAL_IMP(MARILINK1,DESTINATIONS,PERIODS):Y_IMP;
SEMI_INTERMODAL_EXP(DESTINATIONS,MARILINK2,PERIODS):Y_EXP;
!-------------------------------------------------------------------------------;
! Marine &railway transportation network (for intermodal transportation);
MARIRAILLINK1(ORIGINS,RORO_TERMINALS,TRAIN_TERMINALS)/1 2 1, 1 2 2, 1 2 3, 1 2 4, 1 2 5, 1 2 6, 2 2 1, 2 2 2,
2 2 3, 2 2 4, 2 2 5, 2 2 6, 3 2 1, 3 2 2, 3 2 3, 3 2 4, 3 2 5, 3 2 6/;
MARIRAILLINK2(TRAIN_TERMINALS,RORO_TERMINALS,ORIGINS)/1 2 1, 2 2 1, 3 2 1, 4 2 1, 5 2 1, 6 2 1, 1 2 2, 2 2 2,
3 2 2, 4 2 2, 5 2 2, 6 2 2, 1 2 3, 2 2 3, 3 2 3, 4 2 3, 5 2 3, 6 2 3/;
!Intermodal transportation variables
INTERMODAL_IMP(MARIRAILLINK1,DESTINATIONS,PERIODS):Z_IMP;
INTERMODAL_EXP(DESTINATIONS,MARIRAILLINK2,PERIODS):Z_EXP;
!-------------------------------------------------------------------------------;
! Company's own ships' lines;
LINK_IJ1(ORIGINS,RORO_TERMINALS)/1 1, 1 2, 2 3/:D_IJ;
LINK_JI1(RORO_TERMINALS,ORIGINS)/1 1, 2 1, 3 2/:D_JI;
LINK_IJ11(ORIGINS,RORO_TERMINALS)/1 2, 2 3/;
LINK_JI11(RORO_TERMINALS,ORIGINS)/2 1, 3 2/;
LINK_SPOT_IMP(ORIGINS,RORO_TERMINALS)/1 2, 2 2, 3 2/:DS_IJ;
LINK_SPOT_EXP(RORO_TERMINALS,ORIGINS)/2 1, 2 2, 2 3/:DS_JI;
! Outsourced ships' lines
LINK_IJ2(ORIGINS,RORO_TERMINALS)/1 2, 1 4, 2 2, 3 2/:PD_IJ;
LINK_JI2(RORO_TERMINALS,ORIGINS)/2 1, 4 1, 2 2, 2 3/:PD_JI;
! Variables related to marine transport;
SHIPPMENT_IJ_IMP1(LINK_IJ1,PERIODS):N_IMP,OWN_IMP,SIJ_IMP,N_IMPP,N_IMPO;
SHIPPMENT_IJ_IMP11(LINK_IJ11,PERIODS):UTI_IMP;
SHIPPMENT_IJ_IMP2(LINK_IJ2,PERIODS):PUB_IJ_IMP;
SHIPPMENT_JI_EXP1(LINK_JI1,PERIODS):N_EXP,OWN_EXP,SJI_EXP,N_EXPP,N_EXPO;
SHIPPMENT_JI_EXP11(LINK_JI11,PERIODS):UTI_EXP;
SHIPPMENT_JI_EXP2(LINK_JI2,PERIODS):PUB_JI_EXP;
!-------------------------------------------------------------------------------;
! Railway transportation network and transit times,
FULLTRAIN_IMP(RORO_TERMINALS,TRAIN_TERMINALS)/2 1, 2 2, 2 3, 2 4, 2 5, 2 6/:TR_JK,TR_JKP,TR_JKO;
FULLTRAIN_EXP(TRAIN_TERMINALS,RORO_TERMINALS)/1 2, 2 2, 3 2, 4 2, 5 2, 6 2/:TR_KJ,TR_KJP,TR_KJO;
! Public train lines;
LINK_JK(RORO_TERMINALS,TRAIN_TERMINALS)/2 2/:PD_JK;
LINK_KJ(TRAIN_TERMINALS,RORO_TERMINALS)/2 2/:PD_KJ;
PUBTRAINLINK1(TRAIN_TERMINALS,TRAIN_TERMINALS)/4 5, 4 6/:D_SK;
PUBTRAINLINK2(TRAIN_TERMINALS,TRAIN_TERMINALS)/5 4, 6 4/:D_KS;
! Blok train lines;
TRAINLINK1(RORO_TERMINALS,TRAIN_TERMINALS)/2 1, 2 3, 2 4/:DD_JK;
TRAINLINK2(TRAIN_TERMINALS,RORO_TERMINALS)/1 2, 3 2, 4 2/:DD_KJ;
! Variables related to railway transportation;
SHIPPMENT_JK_IMP(LINK_JK,PERIODS):PUB_JK_IMP;
SHIPPMENT_KJ_EXP(LINK_KJ,PERIODS):PUB_KJ_EXP;
SHIPPMENT_SJK_IMP(TRAINLINK1,PERIODS):SJK_IMP,M_IMP,M_IMPP,M_IMPO;
SHIPPMENT_SKJ_EXP(TRAINLINK2,PERIODS):SKJ_EXP,M_EXP,M_EXPP,M_EXPO;
! Variables related to hub station (cologne);
SHIPPMENT_KK_IMP(PUBTRAINLINK1,PERIODS):PUB_SK_IMP;
SHIPPMENT_KK_EXP(PUBTRAINLINK2,PERIODS):PUB_KS_EXP;
!-------------------------------------------------------------------------------;
!Parameters related to Marine and railway taransportation;
COST_IJ1(ORIGINS,RORO_TERMINALS)/1 1, 1 2, 2 3/:C_IJ,CAP_RORO_IMP,C_IJP,C_IJO,CAP_RORO_IMPP,CAP_RORO_IMPO;
COST_IJ2(ORIGINS,RORO_TERMINALS)/1 2, 1 4, 2 2, 3 2/:C_IJ2,C_IJ2P,C_IJ2O;
COST_JI1(RORO_TERMINALS,ORIGINS)/1 1, 2 1, 3 2/:C_JI,CAP_RORO_EXP,C_JIP,C_JIO,CAP_RORO_EXPP,CAP_RORO_EXPO;
COST_JI2(RORO_TERMINALS,ORIGINS)/2 1, 4 1, 2 2, 2 3/:C_JI2,C_JI2P,C_JI2O;
COST_JK1(RORO_TERMINALS,TRAIN_TERMINALS)/2 1, 2 3, 2
4/:C_JK,CAP_TRAIN_IMP,MU_IMP,C_JKP,C_JKO,CAP_TRAIN_IMPP,CAP_TRAIN_IMPO,MU_IMPP,MU_IMPO;
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COST_JK2(RORO_TERMINALS,TRAIN_TERMINALS)/2 2/:C_JK2,C_JK2P,C_JK2O;
COST_KJ1(TRAIN_TERMINALS,RORO_TERMINALS)/1 2, 3 2, 4
2/:C_KJ,CAP_TRAIN_EXP,MU_EXP,C_KJP,C_KJO,CAP_TRAIN_EXPP,CAP_TRAIN_EXPO,MU_EXPP,MU_EXPO;
COST_KJ2(TRAIN_TERMINALS,RORO_TERMINALS)/2 2/:C_KJ2,C_KJ2P,C_KJ2O;
COST_KK1(TRAIN_TERMINALS,TRAIN_TERMINALS)/4 5, 4 6/:C_KKK1,C_KKK1P,C_KKK1O;
COST_KK2(TRAIN_TERMINALS,TRAIN_TERMINALS)/5 4, 6 4/:C_KKK2,C_KKK2P,C_KKK2O;
!Distances and transit times related to road transportation
DISTANCE_JL(RORO_TERMINALS,DESTINATIONS):D_JL,T_JL,T_JLP,T_JLO;
DISTANCE_LJ(DESTINATIONS,RORO_TERMINALS):D_LJ,T_LJ,T_LJP,T_LJO;
DISTANCE_KL(TRAIN_TERMINALS,DESTINATIONS):D_KL,T_KL,T_KLP,T_KLO;
DISTANCE_LK(DESTINATIONS,TRAIN_TERMINALS):D_LK,T_LK,T_LKP,T_LKO;
DISTANCE_IL(ORIGINS,DESTINATIONS):D_IL,T_IL,T_ILP,T_ILO;
DISTANCE_LI(DESTINATIONS,ORIGINS):D_LI,T_LI,T_LIP,T_LIO;
DISTANCE_JK(RORO_TERMINALS,TRAIN_TERMINALS):D_JK,T_JK,T_JKP,T_JKO;
DISTANCE_KJ(TRAIN_TERMINALS,RORO_TERMINALS):D_KJ,T_KJ,T_KJP,T_KJO;
DISTANCE_KK(TRAIN_TERMINALS,TRAIN_TERMINALS):D_KK,T_KK,T_KKP,T_KKO;
DISTANCE_JJ(RORO_TERMINALS,RORO_TERMINALS):D_JJ,T_JJ,T_JJP,T_JJO;
DISTANCE_LL(DESTINATIONS,DESTINATIONS):D_LL,T_LL,T_LLP,T_LLO;
DISTANCE_II(ORIGINS,ORIGINS):D_II,T_II,T_IIP,T_IIO;
!Periodic truck & trailer inventories number of idle trucks & trailers, purchase&sale decisions
NODE_I(ORIGINS,PERIODS):V_IE,ST_I,V_IT,IDLE_IE,IDLE_DORI,IDLE_IT;
NODE_IP(ORIGINS,PERIODS)|&1#EQ#1:AL_T,AL_D,SAT_T,SAT_D;
NODE_J(RORO_TERMINALS,PERIODS):V_J,IDLE_J;
NODE_K(TRAIN_TERMINALS,PERIODS):V_K,IDLE_K;
NODE_L(DESTINATIONS,PERIODS):V_LE,ST_L,V_LT,IDLE_LE,IDLE_DORL,IDLE_LT,WOH,WOHP,WOHO;
NODE_LP(DESTINATIONS,PERIODS)|&1#LE#10:AL_E,SAT_E;
!Loaded truck & trailer positions, internal external repositions
RE_JL(RORO_TERMINALS,DESTINATIONS,PERIODS):VD_JL,V_JL,REPP_JL,REP_JL,VEC_JL,VV_JL,VVX_JL;

RE_LJ(DESTINATIONS,RORO_TERMINALS,PERIODS):VD_LJ,V_LJ,REPP_LJ,REP_LJ,VEC_LJ,VV_LJ,VVX_LJ;

RE_KL(TRAIN_TERMINALS,DESTINATIONS,PERIODS):VD_KL,V_KL,REPP_KL,REP_KL,VEC_KL,VV_KL,VVX_KL;

RE_LK(DESTINATIONS,TRAIN_TERMINALS,PERIODS):VD_LK,V_LK,REPP_LK,REP_LK,VEC_LK,VV_LK,VVX_LK;
RE_IL(ORIGINS,DESTINATIONS,PERIODS):VD_ILE,VD_ILT,V_ILE,V_ILT,REPP_ILE,REP_ILE,TRAI_IL,EP_IL,TP_IL,STT_IL,ST_
IL,REPP_ILT,REP_ILT,EXREP_ILE,EXREP_ILT,EXST_IL,EXREPX_ILE,EXREPX_ILT,EXSTX_IL;
RE_LI(DESTINATIONS,ORIGINS,PERIODS):VD_LIE,VD_LIT,V_LIE,V_LIT,REPP_LIE,REP_LIE,TRAI_LI,EP_LI,TP_LI,STT_LI,ST_
LI,REPP_LIT,REP_LIT,EXREP_LIE,EXREP_LIT,EXST_LI,EXREPX_LIE,EXREPX_LIT,EXSTX_LI;
RE_JK(RORO_TERMINALS,TRAIN_TERMINALS,PERIODS):V_JK,VX_JK;
RE_KJ(TRAIN_TERMINALS,RORO_TERMINALS,PERIODS):V_KJ,VX_KJ;
REPOSITION_K(TRAIN_TERMINALS,TRAIN_TERMINALS,PERIODS):V_KK,VX_KK;
REPOSITION_J(RORO_TERMINALS,RORO_TERMINALS,PERIODS):V_JJ,VX_JJ;
REPOSITION_L(DESTINATIONS,DESTINATIONS,PERIODS):V_LL,ST_LL,TT_LL,VX_LL,STX_LL,TTX_LL;
REPOSITION_I(ORIGINS,ORIGINS,PERIODS):V_II,ST_II,VX_II,STX_II;
ENDSETS

DATA:
! Loading data from excel sheet;
DE_IMP_MU,DE_EXP_MU,C_SP_IMP,C_SP_EXP,N_IMP,N_EXP,M_IMP,M_EXP,C_IJ,C_JI,CAP_RORO_IMP,CAP_RORO_EXP,C_IJ2,C_JI2
,C_JK,C_KJ,CAP_TRAIN_IMP,CAP_TRAIN_EXP,C_JK2,C_KJ2,C_KKK1,
C_KKK2,D_JL,D_LJ,D_KL,D_LK,D_IL,D_LI,C_ROAD,MU_IMP,MU_EXP,TT_IJ,TT_JI,TR_KJ,TR_JK,T_IL,T_LI,T_JL,T_LJ,T_KL,T_
LK,CEK,CEKDOR,FC_D,FC_TC,FC_EC,WOH,HR,AVE,AVT,AVD,D_KK,D_LL,D_JJ,D_II,
D_JK,D_KJ,PC_E,PC_T,PC_D,SP_E,SP_T,SP_D,C_IJP,C_IJO,C_JIP,C_JIO,C_IJ2P,C_IJ2O,C_JI2P,C_JI2O,C_JKP,C_JKO,C_KJP
,C_KJO,C_JK2P,C_JK2O,C_KJ2P,C_KJ2O,C_KKK1P,C_KKK1O,
C_KKK2P,C_KKK2O,C_ROADP,C_ROADO,C_SP_IMPP,C_SP_IMPO,C_SP_EXPP,C_SP_EXPO,FC_ECP,FC_ECO,FC_TCP,FC_TCO,FC_DP,FC_
DO,CEKP,CEKO,CEKDORP,CEKDORO,PC_TP,PC_TO,PC_EP,PC_EO,PC_DP,PC_DO,
SP_TP,SP_TO,SP_EP,SP_EO,SP_DP,SP_DO,N_IMPP,N_IMPO,N_EXPP,N_EXPO,CAP_RORO_IMPP,CAP_RORO_IMPO,CAP_RORO_EXPP,CAP
_RORO_EXPO,CAP_TRAIN_IMPP,CAP_TRAIN_IMPO,CAP_TRAIN_EXPP,CAP_TRAIN_EXPO,
M_IMPP,M_IMPO,M_EXPP,M_EXPO,MU_IMPP,MU_IMPO,MU_EXPP,MU_EXPO,WOHP,WOHO,AVEP,AVEO,AVTP,AVTO,AVDP,AVDO,T_JLP,T_J
LO,T_LJP,T_LJO,T_KLP,T_KLO,T_LKP,T_LKO,T_ILP,T_ILO,T_LIP,T_LIO,
TT_IJP,TT_IJO,TT_JIP,TT_JIO,TR_JKP,TR_JKO,TR_KJP,TR_KJO,DE_IMP_STD,DE_EXP_STD,CO2_KARAP,CO2_KARA,CO2_KARAO,CO
2_DENIZP,CO2_DENIZ,CO2_DENIZO,CO2_TRENP,CO2_TREN,CO2_TRENO,D_IJ,D_JI,
PD_IJ,PD_JI,DD_JK,DD_KJ,PD_JK,PD_KJ,D_SK,D_KS,Rate_KP,Rate_K,Rate_KO,Rate_KDP,Rate_KD,Rate_KDO,DS_IJ,DS_JI,T_
JKP,T_JK,T_JKO,T_KJP,T_KJ,T_KJO,T_KKP,T_KK,T_KKO,T_JJP,T_JJ,T_JJO,T_LLP,
T_LL,T_LLO,T_IIP,T_II,T_IIO,CO2_REPP,CO2_REP,CO2_REPO=
@OLE('C:\Users\kemal.subulan\Desktop\Mayıs_son_run_bilg2\Deterministik_ve_fuzzy_veriler.xlsx','DE_IMP','DE_EX
P',
'C_SP_IMP','C_SP_EXP','N_IMP','N_EXP','M_IMP','M_EXP','C_IJ','C_JI','CAP_RORO_IMP','CAP_RORO_EXP','C_IJ2','C_
JI2','C_JK','C_KJ','CAP_TRAIN_IMP','CAP_TRAIN_EXP','C_JK2','C_KJ2','C_KKK1',
'C_KKK2','D_JL','D_LJ','D_KL','D_LK','D_IL','D_LI','C_ROAD','MU_IMP','MU_EXP','TT_IJ','TT_JI','TR_KJ','TR_JK'
,'T_IL','T_LI','T_JL','T_LJ','T_KL','T_LK','CEK','CEKDOR','FC_D','FC_TC','FC_EC',
'WOH','HR','AVE','AVT','AVD','D_KK','D_LL','D_JJ','D_II','D_JK','D_KJ','PC_E','PC_T','PC_D','SP_E','SP_T','SP
_D','C_IJP','C_IJO','C_JIP','C_JIO','C_IJ2P',
'C_IJ2O','C_JI2P','C_JI2O','C_JKP','C_JKO','C_KJP','C_KJO','C_JK2P','C_JK2O','C_KJ2P','C_KJ2O','C_KKK1P','C_K
KK1O','C_KKK2P','C_KKK2O','C_ROADP','C_ROADO','C_SP_IMPP','C_SP_IMPO',
'C_SP_EXPP','C_SP_EXPO','FC_ECP','FC_ECO','FC_TCP','FC_TCO','FC_DP','FC_DO','CEKP','CEKO','CEKDORP','CEKDORO'
,'PC_TP','PC_TO','PC_EP','PC_EO','PC_DP','PC_DO','SP_TP','SP_TO',
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'SP_EP','SP_EO','SP_DP','SP_DO','N_IMPP','NIMPO','N_EXPP','N_EXPO','CAP_RORO_IMPP','CAP_RORO_IMPO','CAP_RORO_
EXPP','CAP_RORO_EXPO','CAP_TRAIN_IMPP','CAP_TRAIN_IMPO','CAP_TRAIN_EXPP',
'CAP_TRAIN_EXPO','M_IMPP','M_IMPO','M_EXPP','M_EXPO','MU_IMPP','MU_IMPO','MU_EXPP','MU_EXPO','WOHP','WOHO','A
VEP','AVEO','AVTP','AVTO','AVDP','AVDO','T_JLP','T_JLO','T_LJP','T_LJO',
'T_KLP','T_KLO','T_LKP','T_LKO','T_ILP','T_ILO','T_LIP','T_LIO','TT_IJP','TT_IJO','TT_JIP','TT_JIO','TR_JKP',
'TR_JKO','TR_KJP','TR_KJO','DE_IMP_STD','DE_EXP_STD','CO2_KARAP','CO2_KARA',
'CO2_KARAO','CO2_DENIZP','CO2_DENIZ','CO2_DENIZO','CO2_TRENP','CO2_TREN','CO2_TRENO','D_IJ','D_JI','PD_IJ','P
D_JI','DD_JK','DD_KJ','PD_JK','PD_KJ','D_SK','D_KS','Rate_KP','Rate_K',
'Rate_KO','Rate_KDP','Rate_KD','Rate_KDO','DS_IJ','DS_JI','T_JKP','T_JK','T_JKO','T_KJP','T_KJ','T_KJO','T_KK
P','T_KK','T_KKO','T_JJP','T_JJ','T_JJO','T_LLP',
'T_LL','T_LLO','T_IIP','T_II','T_IIO','CO2_REPP','CO2_REP','CO2_REPO');
V_IE0,V_IT0,ST_I0,V_J0,V_K0,V_LT0,ST_L0,V_LE0=@OLE('C:\Users\kemal.subulan\Desktop\Mayıs_son_run_bilg2\Cekici
_ve_Dorse_Envanterleri.xlsx','V_IE0','V_IT0','ST_I0','V_J0',
'V_K0','V_LT01','ST_L0','V_LE0');
!Writing Load-Plan results to excel sheet;
@OLE('C:\Users\kemal.subulan\Desktop\Mayıs_son_run_bilg2\yuk_planlama.xlsx','OWN_IMP','OWN_EXP','PUB_IJ_IMP',
'PUB_JI_EXP','SJK_IMP','SKJ_EXP','PUB_JK_IMP','PUB_KJ_EXP',
'PUB_SK_IMP','PUB_KS_EXP','X_IMP','Y_IMP','Z_IMP','X_EXP','Y_EXP','Z_EXP','UTI_IMP1','UTI_EXP1','SIJ_IMP11','
SJI_EXP11','SP_IL','SP_LI','ZCOST',
'Z_TIME','Z_ENVIRONMENT','ZPES','ZMOS','ZOPT','ZTPES','ZTMOS','ZTOPT','ZEPES','ZEMOS','ZEOPT')=
OWN_IMP,OWN_EXP,PUB_IJ_IMP,PUB_JI_EXP,SJK_IMP,SKJ_EXP,PUB_JK_IMP,PUB_KJ_EXP,PUB_SK_IMP,PUB_KS_EXP,X_IMP,Y_IMP
,Z_IMP,X_EXP,Y_EXP,Z_EXP,UTI_IMP,UTI_EXP,SIJ_IMP,SJI_EXP,
SP_IMP,SP_EXP,ZCOST,ZTIME,ZENVIRONMENT,ZPES,ZMOS,ZOPT,ZTPES,ZTMOS,ZTOPT,ZEPES,ZEMOS,ZEOPT;
! Writing Fleet-Plan (Trucks inventory) results to excel sheet;
@OLE('C:\Users\kemal.subulan\Desktop\Mayıs_son_run_bilg2\filo_buyuklugu_ve_atama.xlsx','V_IL','V_LI','V_ILT',
'V_LIT','V_JL','V_LJ','V_KL','V_LK',
'TP_IL1','TP_LI1','EP_IL1','EP_LI1','VEC_JL1','VEC_LJ1','VEC_KL1','VEC_LK1','TRAI_IL1','TRAI_LI1','REP_JL','R
EP_LJ','REP_KL','REP_LK','REP_ILE','REP_LIE','REP_ILTT','REP_LITT',
'ST_ILT','ST_LIT')=VD_ILE,VD_LIE,VD_ILT,VD_LIT,VD_JL,VD_LJ,VD_KL,VD_LK,TP_IL,TP_LI,EP_IL,EP_LI,VEC_JL,VEC_LJ,
VEC_KL,VEC_LK,TRAI_IL,TRAI_LI,REPP_JL,REPP_LJ,REPP_KL,REPP_LK,REPP_ILE,REPP_LIE,REPP_ILT,
REPP_LIT,STT_IL,STT_LI;
! Writing Fleet-Plan (Trailer inventory) results to excel sheet;
@OLE('C:\Users\kemal.subulan\Desktop\Mayıs_son_run_bilg2\Cekici_ve_Dorse_Envanterleri.xlsx','V_IE0','V_IE','V
_IT0','V_IT','ST_I0','ST_I','V_J0','V_J','V_K0','V_K',
'V_LT01','V_LT1','ST_L0','ST_L','V_LE0','V_LE','ATIL_IE','ATIL_IT','ATIL_DORI','ATIL_J','ATIL_K','ATIL_LE','A
TIL_LT','ATIL_DORL')=V_IE0,V_IE,V_IT0,V_IT,ST_I0,ST_I,V_J0,V_J,V_K0,
V_K,V_LT0,V_LT,ST_L0,ST_L,V_LE0,V_LE,IDLE_IE,IDLE_IT,IDLE_DORI,IDLE_J,IDLE_K,IDLE_LE,IDLE_LT,IDLE_DORL;
! Writing Fleet-Plan (Reposition, purchase-sales decisions) results to excell sheet;
@OLE('C:\Users\kemal.subulan\Desktop\Mayıs_son_run_bilg2\Dis_Repozisyon_Satinalma_Satis.xlsx','VV_JL','VV_LJ'
,'VV_KL','VV_LK',
'EXST_IL','EXST_LI','EXREP_ILE','EXREP_LIE','EXREP_ILT','EXREP_LIT','V_JK','V_KJ','V_KK','V_JJ','V_LL','ST_LL
','TT_LLYY','V_II','ST_II','AL_T','SAT_T','AL_D','SAT_D','AL_E','SAT_E')=
VVX_JL,VVX_LJ,VVX_KL,VVX_LK,EXSTX_IL,EXSTX_LI,EXREPX_ILE,EXREPX_LIE,EXREPX_ILT,EXREPX_LIT,VX_JK,VX_KJ,VX_KK,V
X_JJ,VX_LL,STX_LL,TTX_LL,VX_II,STX_II,AL_T,SAT_T,AL_D,SAT_D,AL_E,SAT_E;
!Monthly costs, Transit times, CO2 emission and their components;
@OLE('C:\Users\kemal.subulan\Desktop\Mayıs_son_run_bilg2\Aylık_Hedef_Degerler.xlsx','Aylik_Maliyet','ZM_1','Z
M_2','ZM_3','ZM_4','ZM_5','ZM_6','ZM_7','ZM_8','ZM_9','Aylik_Sure','ZT_1','ZT_2',
'ZT_3','ZT_4','ZT_5','Aylik_CO2','ZE_1','ZE_2','ZE_3','ZE_4','ZE_5')=Aylik_Maliyet,ZM1,ZM2,ZM3,ZM4,ZM5,ZM6,ZM
7,ZM8,ZM9,Aylik_Sure,ZT1,ZT2,ZT3,ZT4,ZT5,Aylik_CO2,ZE1,ZE2,ZE3,ZE4,ZE5;
!Loaded & Empty Truck & Trailer positions
@OLE('C:\Users\kemal.subulan\Desktop\Mayıs_son_run_bilg2\Pozisyon_sayilari_cinsinden.xlsx','V_ILE','V_LIE','V
_ILT','V_LIT','V_JL','V_LJ','V_KL','V_LK','REP_JL','REP_LJ',
'REP_KL','REP_LK','REP_ILE','REP_LIE','REP_ILT','REP_LIT','ST_IL','ST_LI','VV_JL','VV_LJ','VV_KL','VV_LK','EX
ST_IL','EXST_LI','EXREP_ILE','EXREP_LIE','EXREP_ILT','EXREP_LIT',
'V_JK','V_KJ','V_KK','V_JJ','V_LL','ST_LL','TT_LL','V_II','ST_II')=V_ILE,V_LIE,V_ILT,V_LIT,V_JL,V_LJ,V_KL,V_L
K,REP_JL,REP_LJ,REP_KL,REP_LK,REP_ILE,REP_LIE,REP_ILT,REP_LIT,ST_IL,ST_LI,
VV_JL,VV_LJ,VV_KL,VV_LK,EXST_IL,EXST_LI,EXREP_ILE,EXREP_LIE,EXREP_ILT,EXREP_LIT,V_JK,V_KJ,V_KK,V_JJ,V_LL,ST_L
L,TT_LL,V_II,ST_II;
alpha=1;
NSAMP=5;
Prb1=0.9;
Prb2=0.9;
ENDDATA
```

```
!*(1) Minimize overall transport costs throughout intermodal logistics network:

MAX=0.425*M1+0.334*M2+0.241*M3;

M1<=(278559021.3-ZCOST(1))/63378611.7;
M2<=(10772720.2-ZTIME(1))/688108.1;
M3<=(144393276.7-ZENVIRONMENT(1))/14865710.4;

M1<=1;
M2<=1;
M3<=1;
M1>=0;
M2>=0;
M3>=0;

ZCOST(1)=@SUM(PERIODS(T):ZM1(T)+ZM2(T)+ZM3(T)+ZM4(T)+ZM5(T)+ZM6(T)+ZM7(T)+ZM8(T)+ZM9(T));
!Marine transport costs by company-owned and other logistics service providers' Ro-Ro vessels:
@FOR(PERIODS(T):ZM1(T)=@SUM(COST_IJ1(I,J):OWN_IMP(I,J,T)*((C_IJP(I,J)+2*C_IJ(I,J)+C_IJO(I,J))/4))
+@SUM(COST_IJ2(I,J):PUB_IJ_IMP(I,J,T)*((C_IJ2P(I,J)+2*C_IJ2(I,J)+C_IJ2O(I,J))/4))
+@SUM(COST_JI1(J,I):OWN_EXP(J,I,T)*((C_JIP(J,I)+2*C_JI(J,I)+C_JIO(J,I))/4))
+@SUM(COST_JI2(J,I):PUB_JI_EXP(J,I,T)*((C_JI2P(J,I)+2*C_JI2(J,I)+C_JI2O(J,I))/4)));
!Railway transport costs by fixed schedule of block trains and flexible schedule of public trains:
@FOR(PERIODS(T):ZM2(T)=@SUM(COST_JK1(J,K):SJK_IMP(J,K,T)*((C_JKP(J,K)+2*C_JK(J,K)+C_JKO(J,K))/4))
+@SUM(COST_JK2(J,K):PUB_JK_IMP(J,K,T)*((C_JK2P(J,K)+2*C_JK2(J,K)+C_JK2O(J,K))/4))
+@SUM(COST_KK1(S,K):PUB_SK_IMP(S,K,T)*((C_KKK1P(S,K)+2*C_KKK1(S,K)+C_KKK1O(S,K))/4))
+@SUM(COST_KK2(K,S):PUB_KS_EXP(K,S,T)*((C_KKK2P(K,S)+2*C_KKK2(K,S)+C_KKK2O(K,S))/4))
+@SUM(COST_KJ1(K,J):SKJ_EXP(K,J,T)*((C_KJP(K,J)+2*C_KJ(K,J)+C_KJO(K,J))/4))
+@SUM(COST_KJ2(K,J):PUB_KJ_EXP(K,J,T)*((C_KJ2P(K,J)+2*C_KJ2(K,J)+C_KJ2O(K,J))/4)));
!Road transport cost by European/Turkish plated trucks for loaded movements:
@FOR(PERIODS(T):ZM3(T)=@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*((C_ROADP+2*C_ROAD+C_ROADO)
/4))+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(L,J,I,T)*D_LJ(L,J)*((C_ROADP+2*C_ROAD+C_ROADO)/4))
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*((C_ROADP+2*C_ROAD+C_ROADO)/4))+@SUM(INTERMODAL_EX
P(L,K,J,I,T):Z_EXP(L,K,J,I,T)*D_LK(L,K)*((C_ROADP+2*C_ROAD+C_ROADO)/4))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*D_IL(I,L)*((C_ROADP+2*C_ROAD+C_ROADO)/4)))
)
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*D_LI(L,I)*((C_ROADP+2*C_ROAD+C_ROADO)/4)))
));
!Outsourcing costs in direct road and combined marine & road transportation:
@FOR(PERIODS(T):ZM4(T)=@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*((C_SP_IMPP(I,L,T)+2*C_SP_IMP(I,L,T)+C_SP_IMPO
(I,L,T))/4))
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*((C_SP_EXPP(L,I,T)+2*C_SP_EXP(L,I,T)+C_SP_EXPO(L,I,T))/4)));
!Fixed ownership costs for European/Turkish plated trucks and trailers:
@FOR(PERIODS(T):ZM5(T)=@SUM(RE_JL(J,L,T):VEC_JL(J,L,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(RE_LJ(L,J,T):VEC_LJ(
L,J,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))
+@SUM(RE_KL(K,L,T):VEC_KL(K,L,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(RE_LK(L,K,T):VEC_LK(L,K,T)*((FC_ECP+2*FC_E
C+FC_ECO)/4))
+@SUM(RE_IL(I,L,T):EP_IL(I,L,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(RE_IL(I,L,T):TP_IL(I,L,T)*((FC_TCP+2*FC_TC+
FC_TCO)/4))+@SUM(RE_LI(L,I,T):EP_LI(L,I,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))
+@SUM(RE_LI(L,I,T):TP_LI(L,I,T)*((FC_TCP+2*FC_TC+FC_TCO)/4))+@SUM(RE_LI(L,I,T):TRAI_LI(L,I,T)*((FC_DP+2*FC_D+
FC_DO)/4))+@SUM(RE_IL(I,L,T):TRAI_IL(I,L,T)*((FC_DP+2*FC_D+FC_DO)/4)));
!Internal empty truck and trailer repositioning costs:
@FOR(PERIODS(T):ZM6(T)=@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_LJ(L,J,T):REP
_LJ(L,J,T)*D_LJ(L,J)*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*D_LK(L,K)*(
(CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*D_IL(I,L)
*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*D_IL(I,L)
*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4))
+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*D_LI(L,I)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4)));
!External empty truck and trailer repositioning costs:
@FOR(PERIODS(T):ZM7(T)=@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_KJ(K,J,T):V_KJ(
K,J,T)*D_KJ(K,J)*((CEKP+2*CEK+CEKO)/4))
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*D_JL(J,
L)*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*((CEKP+2*CEK+CEKO)/4))+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*D_LL(L,
C)*((CEKP+2*CEK+CEKO)/4))
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*D_KL(K,L)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*((C
EKP+2*CEK+CEKO)/4))
+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*D_KK(K,B)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_I
L(I,L)*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*D_LI(L,I)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(
I,L)*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*D_LI(L,I)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,
L)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4))
+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*D_LI(L,I)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4))
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+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*D_LL(L,C)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-
CEKO))/4))+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*((CEKDORP+2*CEKDOR+CEKDORO)/4)));
! Fixed ownership costs for idle or inactive trucks and trailers:
@FOR(PERIODS(T):ZM8(T)=@SUM(NODE_IP(I,T):AL_T(I,T)*((PC_TP+2*PC_T+PC_TO)/4))+@SUM(NODE_LP(L,T):AL_E(L,T)*((PC
_EP+2*PC_E+PC_EO)/4))+@SUM(NODE_IP(I,T):AL_D(I,T)*((PC_DP+2*PC_D+PC_DO)/4))
-@SUM(NODE_IP(I,T):SAT_T(I,T)*((SP_TP+2*SP_T+SP_TO)/4))-
@SUM(NODE_IP(I,T):SAT_D(I,T)*((SP_DP+2*SP_D+SP_DO)/4))-
@SUM(NODE_LP(L,T):SAT_E(L,T)*((SP_EP+2*SP_E+SP_EO)/4)));
! Purchasing costs for European/Turkish plated new trucks and trailers:
@FOR(PERIODS(T):ZM9(T)=@SUM(ORIGINS(I):IDLE_IE(I,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(RORO_TERMINALS(J):IDLE_
J(J,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))
+@SUM(TRAIN_TERMINALS(K):IDLE_K(K,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(DESTINATIONS(L):IDLE_LE(L,T)*((FC_ECP+
2*FC_EC+FC_ECO)/4))
+@SUM(ORIGINS(I):IDLE_IT(I,T)*((FC_TCP+2*FC_TC+FC_TCO)/4))+@SUM(DESTINATIONS(L):IDLE_LT(L,T)*((FC_TCP+2*FC_TC
+FC_TCO)/4))
+@SUM(ORIGINS(I):IDLE_DORI(I,T)*((FC_DP+2*FC_D+FC_DO)/4))+@SUM(DESTINATIONS(L):IDLE_DORL(L,T)*((FC_DP+2*FC_D+
FC_DO)/4)));
ZPES(1)=@SUM(COST_IJ1(I,J):@SUM(PERIODS(T):OWN_IMP(I,J,T)*C_IJP(I,J)))
+@SUM(COST_IJ2(I,J):@SUM(PERIODS(T):PUB_IJ_IMP(I,J,T)*C_IJ2P(I,J)))
+@SUM(COST_JI1(J,I):@SUM(PERIODS(T):OWN_EXP(J,I,T)*C_JIP(J,I)))
+@SUM(COST_JI2(J,I):@SUM(PERIODS(T):PUB_JI_EXP(J,I,T)*C_JI2P(J,I)))
+@SUM(COST_JK1(J,K):@SUM(PERIODS(T):SJK_IMP(J,K,T)*C_JKP(J,K)))
+@SUM(COST_JK2(J,K):@SUM(PERIODS(T):PUB_JK_IMP(J,K,T)*C_JK2P(J,K)))
+@SUM(COST_KK1(S,K):@SUM(PERIODS(T):PUB_SK_IMP(S,K,T)*C_KKK1P(S,K)))
+@SUM(COST_KK2(K,S):@SUM(PERIODS(T):PUB_KS_EXP(K,S,T)*C_KKK2P(K,S)))
+@SUM(COST_KJ1(K,J):@SUM(PERIODS(T):SKJ_EXP(K,J,T)*C_KJP(K,J)))
+@SUM(COST_KJ2(K,J):@SUM(PERIODS(T):PUB_KJ_EXP(K,J,T)*C_KJ2P(K,J)))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*C_ROADP)+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(
L,J,I,T)*D_LJ(L,J)*C_ROADP)
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*C_ROADP)+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,
J,I,T)*D_LK(L,K)*C_ROADP)
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*D_IL(I,L)*C_ROADP)))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*D_LI(L,I)*C_ROADP)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*C_SP_IMPP(I,L,T))
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*C_SP_EXPP(L,I,T))
+@SUM(RE_JL(J,L,T):VEC_JL(J,L,T)*FC_ECP)+@SUM(RE_LJ(L,J,T):VEC_LJ(L,J,T)*FC_ECP)
+@SUM(RE_KL(K,L,T):VEC_KL(K,L,T)*FC_ECP)+@SUM(RE_LK(L,K,T):VEC_LK(L,K,T)*FC_ECP)
+@SUM(RE_IL(I,L,T):EP_IL(I,L,T)*FC_ECP)+@SUM(RE_IL(I,L,T):TP_IL(I,L,T)*FC_TCP)+@SUM(RE_LI(L,I,T):EP_LI(L,I,T)
*FC_ECP)
+@SUM(RE_LI(L,I,T):TP_LI(L,I,T)*FC_TCP)+@SUM(RE_LI(L,I,T):TRAI_LI(L,I,T)*FC_DP)+@SUM(RE_IL(I,L,T):TRAI_IL(I,L
,T)*FC_DP)
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*CEKP)+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*D_LJ(L,J)*CEKP)
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*CEKP)+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*D_LK(L,K)*CEKP)
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*CEKP)+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*D_IL(I,L)*CEKP)
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*CEKP)+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*D_IL(I,L)*CEKP)
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*(CEKDORP-CEKP))
+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*D_LI(L,I)*(CEKDORP-CEKP))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*CEKP)+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*D_KJ(K,J)*CEKP)
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*CEKP)+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*D_JL(J,L)*CEKP)
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*CEKP)+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*D_LL(L,C)*CEKP)
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*CEKP)
+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*D_KL(K,L)*CEKP)+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*CEKP)
+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*D_KK(K,B)*CEKP)+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_IL(I,L)*CEKP)
+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*D_LI(L,I)*CEKP)+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(I,L)*CEKP)
+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*D_LI(L,I)*CEKP)+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,L)*(CEKDORP-
CEKP))
+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*D_LI(L,I)*(CEKDORP-CEKP))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*(CEKDORP-CEKP))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*D_LL(L,C)*(CEKDORP-
CEKP))+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*CEKDORP)
+@SUM(NODE_IP(I,T):AL_T(I,T)*PC_TP)+@SUM(NODE_LP(L,T):AL_E(L,T)*PC_EP)+@SUM(NODE_IP(I,T):AL_D(I,T)*PC_DP)
-@SUM(NODE_IP(I,T):SAT_T(I,T)*SP_TP)-@SUM(NODE_IP(I,T):SAT_D(I,T)*SP_DP)-@SUM(NODE_LP(L,T):SAT_E(L,T)*SP_EP)
+@SUM(PERIODS(T):@SUM(ORIGINS(I):IDLE_IE(I,T)*FC_ECP))+@SUM(PERIODS(T):@SUM(RORO_TERMINALS(J):IDLE_J(J,T)*FC_
ECP))
+@SUM(PERIODS(T):@SUM(TRAIN_TERMINALS(K):IDLE_K(K,T)*FC_ECP))+@SUM(PERIODS(T):@SUM(DESTINATIONS(L):IDLE_LE(L,
T)*FC_ECP))
+@SUM(PERIODS(T):@SUM(ORIGINS(I):IDLE_IT(I,T)*FC_TCP))+@SUM(PERIODS(T):@SUM(DESTINATIONS(L):IDLE_LT(L,T)*FC_T
CP))
+@SUM(PERIODS(T):@SUM(ORIGINS(I):IDLE_DORI(I,T)*FC_DP))+@SUM(PERIODS(T):@SUM(DESTINATIONS(L):IDLE_DORL(L,T)*F
C_DP));
ZMOS(1)=@SUM(COST_IJ1(I,J):@SUM(PERIODS(T):OWN_IMP(I,J,T)*C_IJ(I,J)))
+@SUM(COST_IJ2(I,J):@SUM(PERIODS(T):PUB_IJ_IMP(I,J,T)*C_IJ2(I,J)))
+@SUM(COST_JI1(J,I):@SUM(PERIODS(T):OWN_EXP(J,I,T)*C_JI(J,I)))
+@SUM(COST_JI2(J,I):@SUM(PERIODS(T):PUB_JI_EXP(J,I,T)*C_JI2(J,I)))
+@SUM(COST_JK1(J,K):@SUM(PERIODS(T):SJK_IMP(J,K,T)*C_JK(J,K)))
+@SUM(COST_JK2(J,K):@SUM(PERIODS(T):PUB_JK_IMP(J,K,T)*C_JK2(J,K)))
+@SUM(COST_KK1(S,K):@SUM(PERIODS(T):PUB_SK_IMP(S,K,T)*C_KKK1(S,K)))
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+@SUM(COST_KK2(K,S):@SUM(PERIODS(T):PUB_KS_EXP(K,S,T)*C_KKK2(K,S)))
+@SUM(COST_KJ1(K,J):@SUM(PERIODS(T):SKJ_EXP(K,J,T)*C_KJ(K,J)))
+@SUM(COST_KJ2(K,J):@SUM(PERIODS(T):PUB_KJ_EXP(K,J,T)*C_KJ2(K,J)))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*C_ROAD)+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(L
,J,I,T)*D_LJ(L,J)*C_ROAD)
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*C_ROAD)+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J
,I,T)*D_LK(L,K)*C_ROAD)
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*D_IL(I,L)*C_ROAD)))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*D_LI(L,I)*C_ROAD)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*C_SP_IMP(I,L,T))
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*C_SP_EXP(L,I,T))
+@SUM(RE_JL(J,L,T):VEC_JL(J,L,T)*FC_EC)+@SUM(RE_LJ(L,J,T):VEC_LJ(L,J,T)*FC_EC)
+@SUM(RE_KL(K,L,T):VEC_KL(K,L,T)*FC_EC)+@SUM(RE_LK(L,K,T):VEC_LK(L,K,T)*FC_EC)
+@SUM(RE_IL(I,L,T):EP_IL(I,L,T)*FC_EC)+@SUM(RE_IL(I,L,T):TP_IL(I,L,T)*FC_TC)+@SUM(RE_LI(L,I,T):EP_LI(L,I,T)*F
C_EC)
+@SUM(RE_LI(L,I,T):TP_LI(L,I,T)*FC_TC)+@SUM(RE_LI(L,I,T):TRAI_LI(L,I,T)*FC_D)+@SUM(RE_IL(I,L,T):TRAI_IL(I,L,T
)*FC_D)
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*CEK)+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*D_LJ(L,J)*CEK)
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*CEK)+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*D_LK(L,K)*CEK)
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*CEK)+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*D_IL(I,L)*CEK)
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*CEK)+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*D_IL(I,L)*CEK)
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*(CEKDOR-CEK))
+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*D_LI(L,I)*(CEKDOR-CEK))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*CEK)+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*D_KJ(K,J)*CEK)
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*CEK)+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*D_JL(J,L)*CEK)
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*CEK)+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*D_LL(L,C)*CEK)
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*CEK)
+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*D_KL(K,L)*CEK)+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*CEK)
+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*D_KK(K,B)*CEK)+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_IL(I,L)*CEK)
+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*D_LI(L,I)*CEK)+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(I,L)*CEK)
+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*D_LI(L,I)*CEK)+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,L)*(CEKDOR-CEK))
+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*D_LI(L,I)*(CEKDOR-CEK))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*(CEKDOR-CEK))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*D_LL(L,C)*(CEKDOR-
CEK))+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*CEKDOR)
+@SUM(NODE_IP(I,T):AL_T(I,T)*PC_T)+@SUM(NODE_LP(L,T):AL_E(L,T)*PC_E)+@SUM(NODE_IP(I,T):AL_D(I,T)*PC_D)
-@SUM(NODE_IP(I,T):SAT_T(I,T)*SP_T)-@SUM(NODE_IP(I,T):SAT_D(I,T)*SP_D)-@SUM(NODE_LP(L,T):SAT_E(L,T)*SP_E)
+@SUM(PERIODS(T):@SUM(ORIGINS(I):IDLE_IE(I,T)*FC_EC))+@SUM(PERIODS(T):@SUM(RORO_TERMINALS(J):IDLE_J(J,T)*FC_E
C))
+@SUM(PERIODS(T):@SUM(TRAIN_TERMINALS(K):IDLE_K(K,T)*FC_EC))+@SUM(PERIODS(T):@SUM(DESTINATIONS(L):IDLE_LE(L,T
)*FC_EC))
+@SUM(PERIODS(T):@SUM(ORIGINS(I):IDLE_IT(I,T)*FC_TC))+@SUM(PERIODS(T):@SUM(DESTINATIONS(L):IDLE_LT(L,T)*FC_TC
))
+@SUM(PERIODS(T):@SUM(ORIGINS(I):IDLE_DORI(I,T)*FC_D))+@SUM(PERIODS(T):@SUM(DESTINATIONS(L):IDLE_DORL(L,T)*FC
_D));
ZOPT(1)=@SUM(COST_IJ1(I,J):@SUM(PERIODS(T):OWN_IMP(I,J,T)*C_IJO(I,J)))
+@SUM(COST_IJ2(I,J):@SUM(PERIODS(T):PUB_IJ_IMP(I,J,T)*C_IJ2O(I,J)))
+@SUM(COST_JI1(J,I):@SUM(PERIODS(T):OWN_EXP(J,I,T)*C_JIO(J,I)))
+@SUM(COST_JI2(J,I):@SUM(PERIODS(T):PUB_JI_EXP(J,I,T)*C_JI2O(J,I)))
+@SUM(COST_JK1(J,K):@SUM(PERIODS(T):SJK_IMP(J,K,T)*C_JKO(J,K)))
+@SUM(COST_JK2(J,K):@SUM(PERIODS(T):PUB_JK_IMP(J,K,T)*C_JK2O(J,K)))
+@SUM(COST_KK1(S,K):@SUM(PERIODS(T):PUB_SK_IMP(S,K,T)*C_KKK1O(S,K)))
+@SUM(COST_KK2(K,S):@SUM(PERIODS(T):PUB_KS_EXP(K,S,T)*C_KKK2O(K,S)))
+@SUM(COST_KJ1(K,J):@SUM(PERIODS(T):SKJ_EXP(K,J,T)*C_KJO(K,J)))
+@SUM(COST_KJ2(K,J):@SUM(PERIODS(T):PUB_KJ_EXP(K,J,T)*C_KJ2O(K,J)))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*C_ROADO)+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(
L,J,I,T)*D_LJ(L,J)*C_ROADO)
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*C_ROADO)+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,
J,I,T)*D_LK(L,K)*C_ROADO)
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*D_IL(I,L)*C_ROADO)))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*D_LI(L,I)*C_ROADO)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*C_SP_IMPO(I,L,T))
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*C_SP_EXPO(L,I,T))
+@SUM(RE_JL(J,L,T):VEC_JL(J,L,T)*FC_EC)+@SUM(RE_LJ(L,J,T):VEC_LJ(L,J,T)*FC_ECO)
+@SUM(RE_KL(K,L,T):VEC_KL(K,L,T)*FC_EC)+@SUM(RE_LK(L,K,T):VEC_LK(L,K,T)*FC_ECO)
+@SUM(RE_IL(I,L,T):EP_IL(I,L,T)*FC_EC)+@SUM(RE_IL(I,L,T):TP_IL(I,L,T)*FC_TCO)+@SUM(RE_LI(L,I,T):EP_LI(L,I,T)*
FC_ECO)
+@SUM(RE_LI(L,I,T):TP_LI(L,I,T)*FC_TC)+@SUM(RE_LI(L,I,T):TRAI_LI(L,I,T)*FC_DO)+@SUM(RE_IL(I,L,T):TRAI_IL(I,L,
T)*FC_DO)
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*CEKO)+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*D_LJ(L,J)*CEKO)
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*CEKO)+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*D_LK(L,K)*CEKO)
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*CEKO)+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*D_IL(I,L)*CEKO)
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*CEKO)+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*D_IL(I,L)*CEKO)
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*(CEKDORO-CEKO))
+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*D_LI(L,I)*(CEKDORO-CEKO))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*CEKO)+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*D_KJ(K,J)*CEKO)
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*CEKO)+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*D_JL(J,L)*CEKO)
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*CEKO)+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*D_LL(L,C)*CEKO)
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+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*CEKO)
+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*D_KL(K,L)*CEKO)+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*CEKO)
+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*D_KK(K,B)*CEKO)+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_IL(I,L)*CEKO)
+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*D_LI(L,I)*CEKO)+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(I,L)*CEKO)
+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*D_LI(L,I)*CEKO)+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,L)*(CEKDORO-
CEKO))
+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*D_LI(L,I)*(CEKDORO-CEKO))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*(CEKDORO-CEKO))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*D_LL(L,C)*(CEKDORO-
CEKO))+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*CEKDORO)
+@SUM(NODE_IP(I,T):AL_T(I,T)*PC_TO)+@SUM(NODE_LP(L,T):AL_E(L,T)*PC_EO)+@SUM(NODE_IP(I,T):AL_D(I,T)*PC_DO)
-@SUM(NODE_IP(I,T):SAT_T(I,T)*SP_TO)-@SUM(NODE_IP(I,T):SAT_D(I,T)*SP_DO)-@SUM(NODE_LP(L,T):SAT_E(L,T)*SP_EO)
+@SUM(PERIODS(T):@SUM(ORIGINS(I):IDLE_IE(I,T)*FC_ECO))+@SUM(PERIODS(T):@SUM(RORO_TERMINALS(J):IDLE_J(J,T)*FC_
ECO))
+@SUM(PERIODS(T):@SUM(TRAIN_TERMINALS(K):IDLE_K(K,T)*FC_ECO))+@SUM(PERIODS(T):@SUM(DESTINATIONS(L):IDLE_LE(L,
T)*FC_ECO))
+@SUM(PERIODS(T):@SUM(ORIGINS(I):IDLE_IT(I,T)*FC_TCO))+@SUM(PERIODS(T):@SUM(DESTINATIONS(L):IDLE_LT(L,T)*FC_T
CO))
+@SUM(PERIODS(T):@SUM(ORIGINS(I):IDLE_DORI(I,T)*FC_DO))+@SUM(PERIODS(T):@SUM(DESTINATIONS(L):IDLE_DORL(L,T)*F
C_DO));
!Total revenue obtained from the sales of second-hand trucks and trailers:
@FOR(PERIODS(T):Aylik_Maliyet(T)=@SUM(COST_IJ1(I,J):OWN_IMP(I,J,T)*((C_IJP(I,J)+2*C_IJ(I,J)+C_IJO(I,J))/4))
+@SUM(COST_IJ2(I,J):PUB_IJ_IMP(I,J,T)*((C_IJ2P(I,J)+2*C_IJ2(I,J)+C_IJ2O(I,J))/4))
+@SUM(COST_JI1(J,I):OWN_EXP(J,I,T)*((C_JIP(J,I)+2*C_JI(J,I)+C_JIO(J,I))/4))
+@SUM(COST_JI2(J,I):PUB_JI_EXP(J,I,T)*((C_JI2P(J,I)+2*C_JI2(J,I)+C_JI2O(J,I))/4))
+@SUM(COST_JK1(J,K):SJK_IMP(J,K,T)*((C_JKP(J,K)+2*C_JK(J,K)+C_JKO(J,K))/4))
+@SUM(COST_JK2(J,K):PUB_JK_IMP(J,K,T)*((C_JK2P(J,K)+2*C_JK2(J,K)+C_JK2O(J,K))/4))
+@SUM(COST_KK1(S,K):PUB_SK_IMP(S,K,T)*((C_KKK1P(S,K)+2*C_KKK1(S,K)+C_KKK1O(S,K))/4))
+@SUM(COST_KK2(K,S):PUB_KS_EXP(K,S,T)*((C_KKK2P(K,S)+2*C_KKK2(K,S)+C_KKK2O(K,S))/4))
+@SUM(COST_KJ1(K,J):SKJ_EXP(K,J,T)*((C_KJP(K,J)+2*C_KJ(K,J)+C_KJO(K,J))/4))
+@SUM(COST_KJ2(K,J):PUB_KJ_EXP(K,J,T)*((C_KJ2P(K,J)+2*C_KJ2(K,J)+C_KJ2O(K,J))/4))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*((C_ROADP+2*C_ROAD+C_ROADO)/4))+@SUM(SEMI_INTERMO
DAL_EXP(L,J,I,T):Y_EXP(L,J,I,T)*D_LJ(L,J)*((C_ROADP+2*C_ROAD+C_ROADO)/4))
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*((C_ROADP+2*C_ROAD+C_ROADO)/4))+@SUM(INTERMODAL_EX
P(L,K,J,I,T):Z_EXP(L,K,J,I,T)*D_LK(L,K)*((C_ROADP+2*C_ROAD+C_ROADO)/4))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*D_IL(I,L)*((C_ROADP+2*C_ROAD+C_ROADO)/4)))
)
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*D_LI(L,I)*((C_ROADP+2*C_ROAD+C_ROADO)/4)))
)
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*((C_SP_IMPP(I,L,T)+2*C_SP_IMP(I,L,T)+C_SP_IMPO(I,L,T))/4))
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*((C_SP_EXPP(L,I,T)+2*C_SP_EXP(L,I,T)+C_SP_EXPO(L,I,T))/4))
+@SUM(RE_JL(J,L,T):VEC_JL(J,L,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(RE_LJ(L,J,T):VEC_LJ(L,J,T)*((FC_ECP+2*FC_E
C+FC_ECO)/4))
+@SUM(RE_KL(K,L,T):VEC_KL(K,L,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(RE_LK(L,K,T):VEC_LK(L,K,T)*((FC_ECP+2*FC_E
C+FC_ECO)/4))
+@SUM(RE_IL(I,L,T):EP_IL(I,L,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(RE_IL(I,L,T):TP_IL(I,L,T)*((FC_TCP+2*FC_TC+
FC_TCO)/4))+@SUM(RE_LI(L,I,T):EP_LI(L,I,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))
+@SUM(RE_LI(L,I,T):TP_LI(L,I,T)*((FC_TCP+2*FC_TC+FC_TCO)/4))+@SUM(RE_LI(L,I,T):TRAI_LI(L,I,T)*((FC_DP+2*FC_D+
FC_DO)/4))+@SUM(RE_IL(I,L,T):TRAI_IL(I,L,T)*((FC_DP+2*FC_D+FC_DO)/4))
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*D_LJ(L,J)*(
(CEKP+2*CEK+CEKO)/4))
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*D_LK(L,K)*(
(CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*D_IL(I,L)
*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*D_IL(I,L)
*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4))
+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*D_LI(L,I)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*D_KJ(K,J)*((CEK
P+2*CEK+CEKO)/4))
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*D_JL(J,
L)*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*((CEKP+2*CEK+CEKO)/4))+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*D_LL(L,
C)*((CEKP+2*CEK+CEKO)/4))
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*D_KL(K,L)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*((C
EKP+2*CEK+CEKO)/4))
+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*D_KK(K,B)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_I
L(I,L)*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*D_LI(L,I)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(
I,L)*((CEKP+2*CEK+CEKO)/4))
+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*D_LI(L,I)*((CEKP+2*CEK+CEKO)/4))+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,
L)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4))
+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*D_LI(L,I)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-CEKO))/4))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*D_LL(L,C)*(((CEKDORP-CEKP)+2*(CEKDOR-CEK)+(CEKDORO-
CEKO))/4))+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*((CEKDORP+2*CEKDOR+CEKDORO)/4))
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+@SUM(NODE_IP(I,T):AL_T(I,T)*((PC_TP+2*PC_T+PC_TO)/4))+@SUM(NODE_LP(L,T):AL_E(L,T)*((PC_EP+2*PC_E+PC_EO)/4))+
@SUM(NODE_IP(I,T):AL_D(I,T)*((PC_DP+2*PC_D+PC_DO)/4))
-@SUM(NODE_IP(I,T):SAT_T(I,T)*((SP_TP+2*SP_T+SP_TO)/4))-
@SUM(NODE_IP(I,T):SAT_D(I,T)*((SP_DP+2*SP_D+SP_DO)/4))-@SUM(NODE_LP(L,T):SAT_E(L,T)*((SP_EP+2*SP_E+SP_EO)/4))
+@SUM(ORIGINS(I):IDLE_IE(I,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(RORO_TERMINALS(J):IDLE_J(J,T)*((FC_ECP+2*FC_E
C+FC_ECO)/4))
+@SUM(TRAIN_TERMINALS(K):IDLE_K(K,T)*((FC_ECP+2*FC_EC+FC_ECO)/4))+@SUM(DESTINATIONS(L):IDLE_LE(L,T)*((FC_ECP+
2*FC_EC+FC_ECO)/4))
+@SUM(ORIGINS(I):IDLE_IT(I,T)*((FC_TCP+2*FC_TC+FC_TCO)/4))+@SUM(DESTINATIONS(L):IDLE_LT(L,T)*((FC_TCP+2*FC_TC
+FC_TCO)/4))
+@SUM(ORIGINS(I):IDLE_DORI(I,T)*((FC_DP+2*FC_D+FC_DO)/4))+@SUM(DESTINATIONS(L):IDLE_DORL(L,T)*((FC_DP+2*FC_D+
FC_DO)/4)));
!*(2) Minimize total transit time including loading/unloading times, travel times and awaiting times at the
terminals:
ZTIME(1)=@SUM(PERIODS(T):ZT1(T)+ZT2(T)+ZT3(T)+ZT4(T)+ZT5(T));
! Road freight transit times for loaded truck movements and combined marine/road transit times:
@FOR(PERIODS(T):ZT1(T)=@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):X_IMP(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))
/4)))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):X_EXP(L,I,T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))));
@FOR(PERIODS(T):ZT2(T)=@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*(((TT_IJP(I,J)+2*TT_IJ(I,J)+TT_IJO(I,
J))/4)+((T_JLP(J,L)+2*T_JL(J,L)+T_JLO(J,L))/4)))
+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(L,J,I,T)*(((TT_JIP(J,I)+2*TT_JI(J,I)+TT_JIO(J,I))/4)+((T_LJP(L,J)+2*
T_LJ(L,J)+T_LJO(L,J))/4))));
! Combined marine, rail and road transit times in intermodal transportation:
@FOR(PERIODS(T):ZT3(T)=@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*(((TT_IJP(I,J)+2*TT_IJ(I,J)+TT_IJO(I,J
))/4)+((TR_JKP(J,K)+2*TR_JK(J,K)+TR_JKO(J,K))/4)+((T_KLP(K,L)+2*T_KL(K,L)+T_KLO(K,L))/4)))
+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T)*(((TT_JIP(J,I)+2*TT_JI(J,I)+TT_JIO(J,I))/4)+((TR_KJP(K,J)+2*
TR_KJ(K,J)+TR_KJO(K,J))/4)+((T_LKP(L,K)+2*T_LK(L,K)+T_LKO(L,K))/4))));
! Marine and road freight transit times for outsourced transportation services:
@FOR(PERIODS(T):ZT4(T)=@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4)*((Rate
_KP+2*Rate_K+Rate_KO)/4))
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4)*((Rate_KP+2*Rate_K+Rate_KO)/
4))
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)*(((T
T_IJP(I,J)+2*TT_IJ(I,J)+TT_IJO(I,J))/4)+((T_JLP(J,L)+2*T_JL(J,L)+T_JLO(J,L))/4))))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)*(((T
T_JIP(J,I)+2*TT_JI(J,I)+TT_JIO(J,I))/4)+((T_LJP(L,J)+2*T_LJ(L,J)+T_LJO(L,J))/4)))));
! Road freight transit times for internal empty truck and trailer movements:
@FOR(PERIODS(T):ZT5(T)=@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*((T_JLP(J,L)+2*T_JL(J,L)+T_JLO(J,L))/4))+@SUM(RE_LJ(L,
J,T):REP_LJ(L,J,T)*((T_LJP(L,J)+2*T_LJ(L,J)+T_LJO(L,J))/4))
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*((T_KLP(K,L)+2*T_KL(K,L)+T_KLO(K,L))/4))+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*((T
_LKP(L,K)+2*T_LK(L,K)+T_LKO(L,K))/4))
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*(
(T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*(
(T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*((T_L
IP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*((T_JKP(J,K)+2*T_JK(J,K)+T_JKO(J,K))/4))+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*((T_KJP
(K,J)+2*T_KJ(K,J)+T_KJO(K,J))/4))
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*((T_JJP(J,N)+2*T_JJ(J,N)+T_JJO(J,N))/4))+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)
*((T_JLP(J,L)+2*T_JL(J,L)+T_JLO(J,L))/4))
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*((T_LJP(L,J)+2*T_LJ(L,J)+T_LJO(L,J))/4))+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)
*((T_LLP(L,C)+2*T_LL(L,C)+T_LLO(L,C))/4))
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*((T_IIP(I,D)+2*T_II(I,D)+T_IIO(I,D))/4))+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)
*((T_KLP(K,L)+2*T_KL(K,L)+T_KLO(K,L))/4))
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*((T_LKP(L,K)+2*T_LK(L,K)+T_LKO(L,K))/4))+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)
*((T_KKP(K,B)+2*T_KK(K,B)+T_KKO(K,B))/4))
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,
T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,
T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*(
(T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*((T_IIP(I,D)+2*T_II(I,D)+T_IIO(I,D))/4))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*((T_LLP(L,C)+2*T_LL(L,C)+T_LLO(L,C))/4))+@SUM(REPOSITION_L(L,C,T):TT_L
L(L,C,T)*((T_LLP(L,C)+2*T_LL(L,C)+T_LLO(L,C))/4)));
ZTPES(1)=@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*T_ILP(I,L))))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*T_LIP(L,I))))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*(TT_IJP(I,J)+T_JLP(J,L)))
+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(L,J,I,T)*(TT_JIP(J,I)+T_LJP(L,J)))
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*(TT_IJP(I,J)+TR_JKP(J,K)+T_KLP(K,L)))
+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T)*(TT_JIP(J,I)+TR_KJP(K,J)+T_LKP(L,K)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*T_ILP(I,L)*Rate_KP)
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*T_LIP(L,I)*Rate_KP)
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*Rate_KDP*(TT_IJP(I,J)+T_JLP(J,L))))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*Rate_KDP*(TT_JIP(J,I)+T_LJP(L,J))))
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*T_JLP(J,L))+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*T_LJP(L,J))
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+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*T_KLP(K,L))+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*T_LKP(L,K))
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*T_LIP(L,I))+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*T_ILP(I,L))
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*T_LIP(L,I))+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*T_ILP(I,L))
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*T_ILP(I,L))+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*T_LIP(L,I))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*T_JKP(J,K))+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*T_KJP(K,J))
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*T_JJP(J,N))+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*T_JLP(J,L))
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*T_LJP(L,J))+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*T_LLP(L,C))
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*T_IIP(I,D))+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*T_KLP(K,L))
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*T_LKP(L,K))+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*T_KKP(K,B))
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*T_ILP(I,L))+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*T_LIP(L,I))
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*T_ILP(I,L))+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*T_LIP(L,I))
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*T_ILP(I,L))+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*T_LIP(L,I))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*T_IIP(I,D))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*T_LLP(L,C))+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*T_LLP(L,C));
ZTMOS(1)=@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*T_IL(I,L))))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*T_LI(L,I))))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*(TT_IJ(I,J)+T_JL(J,L)))
+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(L,J,I,T)*(TT_JI(J,I)+T_LJ(L,J)))
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*(TT_IJ(I,J)+TR_JK(J,K)+T_KL(K,L)))
+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T)*(TT_JI(J,I)+TR_KJ(K,J)+T_LK(L,K)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*T_IL(I,L)*Rate_K)
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*T_LI(L,I)*Rate_K)
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*Rate_KD*(TT_IJ(I,J)+T_JL(J,L))))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*Rate_KD*(TT_JI(J,I)+T_LJ(L,J))))
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*T_JL(J,L))+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*T_LJ(L,J))
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*T_KL(K,L))+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*T_LK(L,K))
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*T_LI(L,I))+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*T_IL(I,L))
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*T_LI(L,I))+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*T_IL(I,L))
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*T_IL(I,L))+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*T_LI(L,I))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*T_JK(J,K))+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*T_KJ(K,J))
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*T_JJ(J,N))+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*T_JL(J,L))
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*T_LJ(L,J))+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*T_LL(L,C))
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*T_II(I,D))+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*T_KL(K,L))
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*T_LK(L,K))+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*T_KK(K,B))
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*T_IL(I,L))+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*T_LI(L,I))
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*T_IL(I,L))+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*T_LI(L,I))
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*T_IL(I,L))+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*T_LI(L,I))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*T_II(I,D))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*T_LL(L,C))+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*T_LL(L,C));
ZTOPT(1)=@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*T_ILO(I,L))))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*T_LIO(L,I))))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*(TT_IJO(I,J)+T_JLO(J,L)))
+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(L,J,I,T)*(TT_JIO(J,I)+T_LJO(L,J)))
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*(TT_IJO(I,J)+TR_JKO(J,K)+T_KLO(K,L)))
+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T)*(TT_JIO(J,I)+TR_KJO(K,J)+T_LKO(L,K)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*T_ILO(I,L)*Rate_KO)
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*T_LIO(L,I)*Rate_KO)
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*Rate_KDO*(TT_IJO(I,J)+T_JLO(J,L))))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*Rate_KDO*(TT_JIO(J,I)+T_LJO(L,J))))
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*T_JLO(J,L))+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*T_LJO(L,J))
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*T_KLO(K,L))+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*T_LKO(L,K))
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*T_LIO(L,I))+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*T_ILO(I,L))
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*T_LIO(L,I))+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*T_ILO(I,L))
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*T_ILO(I,L))+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*T_LIO(L,I))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*T_JKO(J,K))+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*T_KJO(K,J))
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*T_JJO(J,N))+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*T_JLO(J,L))
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*T_LJO(L,J))+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*T_LLO(L,C))
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*T_IIO(I,D))+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*T_KLO(K,L))
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*T_LKO(L,K))+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*T_KKO(K,B))
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*T_ILO(I,L))+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*T_LIO(L,I))
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*T_ILO(I,L))+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*T_LIO(L,I))
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*T_ILO(I,L))+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*T_LIO(L,I))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*T_IIO(I,D))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*T_LLO(L,C))+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*T_LLO(L,C));
!Road freight transit times for the external empty truck and trailer movements::
@FOR(PERIODS(T):Aylik_Sure(T)=@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*((T_ILP(I,L)+
2*T_IL(I,L)+T_ILO(I,L))/4))))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*(((TT_IJP(I,J)+2*TT_IJ(I,J)+TT_IJO(I,J))/4)+((T_JLP(J,L)+2*
T_JL(J,L)+T_JLO(J,L))/4)))
+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(L,J,I,T)*(((TT_JIP(J,I)+2*TT_JI(J,I)+TT_JIO(J,I))/4)+((T_LJP(L,J)+2*
T_LJ(L,J)+T_LJO(L,J))/4)))
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*(((TT_IJP(I,J)+2*TT_IJ(I,J)+TT_IJO(I,J))/4)+((TR_JKP(J,K)+2*
TR_JK(J,K)+TR_JKO(J,K))/4)+((T_KLP(K,L)+2*T_KL(K,L)+T_KLO(K,L))/4)))
+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T)*(((TT_JIP(J,I)+2*TT_JI(J,I)+TT_JIO(J,I))/4)+((TR_KJP(K,J)+2*
TR_KJ(K,J)+TR_KJO(K,J))/4)+((T_LKP(L,K)+2*T_LK(L,K)+T_LKO(L,K))/4)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4)*((Rate_KP+2*Rate_K+Rate_KO)/
4))
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+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4)*((Rate_KP+2*Rate_K+Rate_KO)/
4))
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)*(((T
_IJP(I,J)+2*TT_IJ(I,J)+TT_IJO(I,J))/4)+((T_JLP(J,L)+2*T_JL(J,L)+T_JLO(J,L))/4))))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)*(((T
_JIP(J,I)+2*TT_JI(J,I)+TT_JIO(J,I))/4)+((T_LJP(L,J)+2*T_LJ(L,J)+T_LJO(L,J))/4))))
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*((T_JLP(J,L)+2*T_JL(J,L)+T_JLO(J,L))/4))+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*((T
_LJP(L,J)+2*T_LJ(L,J)+T_LJO(L,J))/4))
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*((T_KLP(K,L)+2*T_KL(K,L)+T_KLO(K,L))/4))+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*((T
_LKP(L,K)+2*T_LK(L,K)+T_LKO(L,K))/4))
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*(
(T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*(
(T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*((T_L
IP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*((T_JKP(J,K)+2*T_JK(J,K)+T_JKO(J,K))/4))+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*((T_KJP
(K,J)+2*T_KJ(K,J)+T_KJO(K,J))/4))
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*((T_JJP(J,N)+2*T_JJ(J,N)+T_JJO(J,N))/4))+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)
*((T_JLP(J,L)+2*T_JL(J,L)+T_JLO(J,L))/4))
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*((T_LJP(L,J)+2*T_LJ(L,J)+T_LJO(L,J))/4))+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)
*((T_LLP(L,C)+2*T_LL(L,C)+T_LLO(L,C))/4))
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*((T_IIP(I,D)+2*T_II(I,D)+T_IIO(I,D))/4))+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)
*((T_KLP(K,L)+2*T_KL(K,L)+T_KLO(K,L))/4))
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*((T_LKP(L,K)+2*T_LK(L,K)+T_LKO(L,K))/4))+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)
*((T_KKP(K,B)+2*T_KK(K,B)+T_KKO(K,B))/4))
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,
T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,
T)*((T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*((T_ILP(I,L)+2*T_IL(I,L)+T_ILO(I,L))/4))+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*(
(T_LIP(L,I)+2*T_LI(L,I)+T_LIO(L,I))/4))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*((T_IIP(I,D)+2*T_II(I,D)+T_IIO(I,D))/4))
+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*((T_LLP(L,C)+2*T_LL(L,C)+T_LLO(L,C))/4))+@SUM(REPOSITION_L(L,C,T):TT_L
L(L,C,T)*((T_LLP(L,C)+2*T_LL(L,C)+T_LLO(L,C))/4)));
!*(3) Minimize total environmental impact (CO2 emissions) by different transport modes:
ZENVIRONMENT(1)=@SUM(PERIODS(T):ZE1(T)+ZE2(T)+ZE3(T)+ZE4(T)+ZE5(T));
! Total CO2 emissions from the loaded truck movements by road freight transport:
@FOR(PERIODS(T):ZE3(T)=@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*((CO2_KARAP+2*CO2_KARA+CO2_
KARAO)/4))+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(L,J,I,T)*D_LJ(L,J)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))+@SUM(INTERMO
DAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T)*D_LK(L,K)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):X_IMP(I,L,T)*D_IL(I,L)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):X_EXP(L,I,T)*D_LI(L,I)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))));
! Total CO2 emissions from the maritime logistics services:
@FOR(PERIODS(T):ZE1(T)=@SUM(COST_IJ1(I,J):OWN_IMP(I,J,T)*D_IJ(I,J)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4))
+@SUM(COST_IJ2(I,J):PUB_IJ_IMP(I,J,T)*PD_IJ(I,J)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4))
+@SUM(COST_JI1(J,I):OWN_EXP(J,I,T)*D_JI(J,I)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4))
+@SUM(COST_JI2(J,I):PUB_JI_EXP(J,I,T)*PD_JI(J,I)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4)));
! Total CO2 emissions from the railway transport services:
@FOR(PERIODS(T):ZE2(T)=@SUM(COST_JK1(J,K):SJK_IMP(J,K,T)*((CAP_TRAIN_IMPP(J,K)+2*CAP_TRAIN_IMP(J,K)+CAP_TRAIN
_IMPO(J,K))/4)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*DD_JK(J,K))
+@SUM(COST_JK2(J,K):PUB_JK_IMP(J,K,T)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*PD_JK(J,K))
+@SUM(COST_KK1(S,K):PUB_SK_IMP(S,K,T)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*D_SK(S,K))
+@SUM(COST_KK2(K,S):PUB_KS_EXP(K,S,T)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*D_KS(K,S))
+@SUM(COST_KJ1(K,J):SKJ_EXP(K,J,T)*((CAP_TRAIN_EXP(K,J)+2*CAP_TRAIN_EXP(K,J)+CAP_TRAIN_EXPO(K,J))/4)*((CO2_TR
ENP+2*CO2_TREN+CO2_TRENO)/4)*DD_KJ(K,J))
+@SUM(COST_KJ2(K,J):PUB_KJ_EXP(K,J,T)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*PD_KJ(K,J)));
! Total CO2 emissions from maritime logistics and road freight transport of outsourced services:
@FOR(PERIODS(T):ZE4(T)=@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)*D_IL(I,L)
*((Rate_KP+2*Rate_K+Rate_KO)/4))
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)*D_LI(L,I)*((Rate_KP+2*Rate_K+Ra
te_KO)/4))
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)*DS_I
J(I,J)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4)))
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)*D
_JL(J,L)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)*DS_J
I(J,I)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4)))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)*D
_LJ(L,J)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4))));
! Total CO2 emissions from internal/external empty truck and trailer movements in road transportation:
@FOR(PERIODS(T):ZE5(T)=@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_L
J(L,J,T):REP_LJ(L,J,T)*D_LJ(L,J)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)
*D_LK(L,K)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_IL(I,L,T):REP_ILE(I,L,
T)*D_IL(I,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
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+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_IL(I,L,T):REP_ILT(I,L,
T)*D_IL(I,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))+@SUM(RE_LI(L,I,T):ST_LI(L,I,T
)*D_LI(L,I)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*D_K
J(K,J)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_JL(J,L,T):VV_JL(J,
L,T)*D_JL(J,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(REPOSITION_L(L,C,T):V_LL(L,
C,T)*D_LL(L,C)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_KL(K,L,T):VV_KL(K,
L,T)*D_KL(K,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(REPOSITION_K(K,B,T):V_KK(K,
B,T)*D_KK(K,B)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_IL(I,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_LI(L,I,T):EXREP_LIE(
L,I,T)*D_LI(L,I)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(I,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_LI(L,I,T):EXREP_LIT(
L,I,T)*D_LI(L,I)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,L)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))+@SUM(RE_LI(L,I,T):EXST_LI(L
,I,T)*D_LI(L,I)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))+@SUM(REPOSITION_L(L,C,
T):ST_LL(L,C,T)*D_LL(L,C)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)));
ZEPES(1)=@SUM(COST_IJ1(I,J):@SUM(PERIODS(T):OWN_IMP(I,J,T)*D_IJ(I,J)*CO2_DENIZP))+@SUM(COST_IJ2(I,J):@SUM(PER
IODS(T):PUB_IJ_IMP(I,J,T)*PD_IJ(I,J)*CO2_DENIZP))
+@SUM(COST_JI1(J,I):@SUM(PERIODS(T):OWN_EXP(J,I,T)*D_JI(J,I)*CO2_DENIZP))+@SUM(COST_JI2(J,I):@SUM(PERIODS(T):
PUB_JI_EXP(J,I,T)*PD_JI(J,I)*CO2_DENIZP))
+@SUM(COST_JK1(J,K):@SUM(PERIODS(T):SJK_IMP(J,K,T)*CAP_TRAIN_IMPP(J,K)*CO2_TRENP*D_JK(J,K)))+@SUM(COST_JK2(J,
K):@SUM(PERIODS(T):PUB_JK_IMP(J,K,T)*CO2_TRENP*PD_JK(J,K)))
+@SUM(COST_KK1(S,K):@SUM(PERIODS(T):PUB_SK_IMP(S,K,T)*CO2_TRENP*D_SK(S,K)))+@SUM(COST_KK2(K,S):@SUM(PERIODS(T
):PUB_KS_EXP(K,S,T)*CO2_TRENP*D_KS(K,S)))
+@SUM(COST_KJ1(K,J):@SUM(PERIODS(T):SKJ_EXP(K,J,T)*CAP_TRAIN_EXPP(K,J)*CO2_TRENP*D_KJ(K,J)))+@SUM(COST_KJ2(K,
J):@SUM(PERIODS(T):PUB_KJ_EXP(K,J,T)*CO2_TRENP*PD_KJ(K,J)))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*CO2_KARAP)+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EX
P(L,J,I,T)*D_LJ(L,J)*CO2_KARAP)
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*CO2_KARAP)+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,
K,J,I,T)*D_LK(L,K)*CO2_KARAP)
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*D_IL(I,L)*CO2_KARAP)))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*D_LI(L,I)*CO2_KARAP)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*CO2_KARAP*D_IL(I,L)*Rate_KP)+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)
*CO2_KARAP*D_LI(L,I)*Rate_KP)
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*Rate_KDP*DS_IJ(I,J)*CO2_DENIZP))
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*CO2_KARAP*D_JL(J,L)*Rate_KDP))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*Rate_KDP*DS_JI(J,I)*CO2_DENIZP))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*CO2_KARAP*D_LJ(L,J)*Rate_KDP))
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*CO2_REPP)+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*D_LJ(L,J)*CO2_REPP)
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*CO2_REPP)+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*D_LK(L,K)*CO2_REPP)
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*CO2_REPP)+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*D_IL(I,L)*CO2_REPP)
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*CO2_REPP)+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*D_IL(I,L)*CO2_REPP)
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*CO2_KARAP)+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*D_LI(L,I)*CO2_KARAP)
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*CO2_REPP)+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*D_KJ(K,J)*CO2_REPP)
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*CO2_REPP)+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*D_JL(J,L)*CO2_REPP)
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*CO2_REPP)+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*D_LL(L,C)*CO2_REPP)
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*CO2_REPP)+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*D_KL(K,L)*CO2_REPP)
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*CO2_REPP)+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*D_KK(K,B)*CO2_REPP)
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_IL(I,L)*CO2_REPP)+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*D_LI(L,I)*CO2_REPP
)
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(I,L)*CO2_REPP)+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*D_LI(L,I)*CO2_REPP
)
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,L)*CO2_KARAP)+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*D_LI(L,I)*CO2_KARAP)
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*CO2_KARAP)+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*D_LL(L,C)*C
O2_KARAP)
+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*CO2_KARAP);
ZEMOS(1)=@SUM(COST_IJ1(I,J):@SUM(PERIODS(T):OWN_IMP(I,J,T)*D_IJ(I,J)*CO2_DENIZ))+@SUM(COST_IJ2(I,J):@SUM(PERI
ODS(T):PUB_IJ_IMP(I,J,T)*PD_IJ(I,J)*CO2_DENIZ))
+@SUM(COST_JI1(J,I):@SUM(PERIODS(T):OWN_EXP(J,I,T)*D_JI(J,I)*CO2_DENIZ))+@SUM(COST_JI2(J,I):@SUM(PERIODS(T):P
UB_JI_EXP(J,I,T)*PD_JI(J,I)*CO2_DENIZ))
+@SUM(COST_JK1(J,K):@SUM(PERIODS(T):SJK_IMP(J,K,T)*CAP_TRAIN_IMP(J,K)*CO2_TREN*D_JK(J,K)))+@SUM(COST_JK2(J,K)
:@SUM(PERIODS(T):PUB_JK_IMP(J,K,T)*CO2_TREN*PD_JK(J,K)))
+@SUM(COST_KK1(S,K):@SUM(PERIODS(T):PUB_SK_IMP(S,K,T)*CO2_TREN*D_SK(S,K)))+@SUM(COST_KK2(K,S):@SUM(PERIODS(T)
:PUB_KS_EXP(K,S,T)*CO2_TREN*D_KS(K,S)))
+@SUM(COST_KJ1(K,J):@SUM(PERIODS(T):SKJ_EXP(K,J,T)*CAP_TRAIN_EXP(K,J)*CO2_TREN*D_KJ(K,J)))+@SUM(COST_KJ2(K,J)
:@SUM(PERIODS(T):PUB_KJ_EXP(K,J,T)*CO2_TREN*PD_KJ(K,J)))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*CO2_KARA)+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP
(L,J,I,T)*D_LJ(L,J)*CO2_KARA)
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*CO2_KARA)+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K
,J,I,T)*D_LK(L,K)*CO2_KARA)
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*D_IL(I,L)*CO2_KARA)))
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+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*D_LI(L,I)*CO2_KARA)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*CO2_KARA*D_IL(I,L)*Rate_K)+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*C
O2_KARA*D_LI(L,I)*Rate_K)
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*Rate_KD*DS_IJ(I,J)*CO2_DENIZ))
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*CO2_KARA*D_JL(J,L)*Rate_KD))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*Rate_KD*DS_JI(J,I)*CO2_DENIZ))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*CO2_KARA*D_LJ(L,J)*Rate_KD))
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*CO2_REP)+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*D_LJ(L,J)*CO2_REP)
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*CO2_REP)+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*D_LK(L,K)*CO2_REP)
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*CO2_REP)+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*D_IL(I,L)*CO2_REP)
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*CO2_REP)+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*D_IL(I,L)*CO2_REP)
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*CO2_KARA)+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*D_LI(L,I)*CO2_KARA)
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*CO2_REP)+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*D_KJ(K,J)*CO2_REP)
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*CO2_REP)+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*D_JL(J,L)*CO2_REP)
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*CO2_REP)+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*D_LL(L,C)*CO2_REP)
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*CO2_REP)+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*D_KL(K,L)*CO2_REP)
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*CO2_REP)+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*D_KK(K,B)*CO2_REP)
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_IL(I,L)*CO2_REP)+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*D_LI(L,I)*CO2_REP)
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(I,L)*CO2_REP)+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*D_LI(L,I)*CO2_REP)
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,L)*CO2_KARA)+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*D_LI(L,I)*CO2_KARA)
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*CO2_KARA)+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*D_LL(L,C)*CO
2_KARA)
+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*CO2_KARA);
ZEOPT(1)=@SUM(COST_IJ1(I,J):@SUM(PERIODS(T):OWN_IMP(I,J,T)*D_IJ(I,J)*CO2_DENIZO))+@SUM(COST_IJ2(I,J):@SUM(PER
IODS(T):PUB_IJ_IMP(I,J,T)*PD_IJ(I,J)*CO2_DENIZO))
+@SUM(COST_JI1(J,I):@SUM(PERIODS(T):OWN_EXP(J,I,T)*D_JI(J,I)*CO2_DENIZO))+@SUM(COST_JI2(J,I):@SUM(PERIODS(T):
PUB_JI_EXP(J,I,T)*PD_JI(J,I)*CO2_DENIZO))
+@SUM(COST_JK1(J,K):@SUM(PERIODS(T):SJK_IMP(J,K,T)*CAP_TRAIN_IMPO(J,K)*CO2_TRENO*D_JK(J,K)))+@SUM(COST_JK2(J,
K):@SUM(PERIODS(T):PUB_JK_IMP(J,K,T)*CO2_TRENO*PD_JK(J,K)))
+@SUM(COST_KK1(S,K):@SUM(PERIODS(T):PUB_SK_IMP(S,K,T)*CO2_TRENO*D_SK(S,K)))+@SUM(COST_KK2(K,S):@SUM(PERIODS(T
):PUB_KS_EXP(K,S,T)*CO2_TRENO*D_KS(K,S)))
+@SUM(COST_KJ1(K,J):@SUM(PERIODS(T):SKJ_EXP(K,J,T)*CAP_TRAIN_EXPO(K,J)*CO2_TRENO*D_KJ(K,J)))+@SUM(COST_KJ2(K,
J):@SUM(PERIODS(T):PUB_KJ_EXP(K,J,T)*CO2_TRENO*PD_KJ(K,J)))
+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*CO2_KARAO)+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EX
P(L,J,I,T)*D_LJ(L,J)*CO2_KARAO)
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*CO2_KARAO)+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,
K,J,I,T)*D_LK(L,K)*CO2_KARAO)
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*D_IL(I,L)*CO2_KARAO)))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*D_LI(L,I)*CO2_KARAO)))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*CO2_KARAO*D_IL(I,L)*Rate_KO)+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)
*CO2_KARAO*D_LI(L,I)*Rate_KO)
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*Rate_KDO*DS_IJ(I,J)*CO2_DENIZO))
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*CO2_KARAO*D_JL(J,L)*Rate_KDO))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*Rate_KDO*DS_JI(J,I)*CO2_DENIZO))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*CO2_KARAO*D_LJ(L,J)*Rate_KDO))
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*CO2_REPO)+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)*D_LJ(L,J)*CO2_REPO)
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*CO2_REPO)+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)*D_LK(L,K)*CO2_REPO)
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*CO2_REPO)+@SUM(RE_IL(I,L,T):REP_ILE(I,L,T)*D_IL(I,L)*CO2_REPO)
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*CO2_REPO)+@SUM(RE_IL(I,L,T):REP_ILT(I,L,T)*D_IL(I,L)*CO2_REPO)
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*CO2_KARAO)+@SUM(RE_LI(L,I,T):ST_LI(L,I,T)*D_LI(L,I)*CO2_KARAO)
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*CO2_REPO)+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*D_KJ(K,J)*CO2_REPO)
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*CO2_REPO)+@SUM(RE_JL(J,L,T):VV_JL(J,L,T)*D_JL(J,L)*CO2_REPO)
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*CO2_REPO)+@SUM(REPOSITION_L(L,C,T):V_LL(L,C,T)*D_LL(L,C)*CO2_REPO)
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*CO2_REPO)+@SUM(RE_KL(K,L,T):VV_KL(K,L,T)*D_KL(K,L)*CO2_REPO)
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*CO2_REPO)+@SUM(REPOSITION_K(K,B,T):V_KK(K,B,T)*D_KK(K,B)*CO2_REPO)
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_IL(I,L)*CO2_REPO)+@SUM(RE_LI(L,I,T):EXREP_LIE(L,I,T)*D_LI(L,I)*CO2_REPO
)
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(I,L)*CO2_REPO)+@SUM(RE_LI(L,I,T):EXREP_LIT(L,I,T)*D_LI(L,I)*CO2_REPO
)
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,L)*CO2_KARAO)+@SUM(RE_LI(L,I,T):EXST_LI(L,I,T)*D_LI(L,I)*CO2_KARAO)
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*CO2_KARAO)+@SUM(REPOSITION_L(L,C,T):ST_LL(L,C,T)*D_LL(L,C)*C
O2_KARAO)
+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*CO2_KARAO);
! Amount of monthly CO2 emission
@FOR(PERIODS(T):Aylik_CO2(T)=@SUM(COST_IJ1(I,J):@SUM(PERIODS(T):OWN_IMP(I,J,T)*D_IJ(I,J)*((CO2_DENIZP+2*CO2_D
ENIZ+CO2_DENIZO)/4)))
+@SUM(COST_IJ2(I,J):@SUM(PERIODS(T):PUB_IJ_IMP(I,J,T)*PD_IJ(I,J)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4)))
+@SUM(COST_JI1(J,I):@SUM(PERIODS(T):OWN_EXP(J,I,T)*D_JI(J,I)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4)))
+@SUM(COST_JI2(J,I):@SUM(PERIODS(T):PUB_JI_EXP(J,I,T)*PD_JI(J,I)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4)))
+@SUM(COST_JK1(J,K):@SUM(PERIODS(T):SJK_IMP(J,K,T)*((CAP_TRAIN_IMPP(J,K)+2*CAP_TRAIN_IMP(J,K)+CAP_TRAIN_IMPO(
J,K))/4)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*DD_JK(J,K)))
+@SUM(COST_JK2(J,K):@SUM(PERIODS(T):PUB_JK_IMP(J,K,T)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*PD_JK(J,K)))
+@SUM(COST_KK1(S,K):@SUM(PERIODS(T):PUB_SK_IMP(S,K,T)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*D_SK(S,K)))
+@SUM(COST_KK2(K,S):@SUM(PERIODS(T):PUB_KS_EXP(K,S,T)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*D_KS(K,S)))
+@SUM(COST_KJ1(K,J):@SUM(PERIODS(T):SKJ_EXP(K,J,T)*((CAP_TRAIN_EXP(K,J)+2*CAP_TRAIN_EXP(K,J)+CAP_TRAIN_EXPO(K
,J))/4)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*DD_KJ(K,J)))
+@SUM(COST_KJ2(K,J):@SUM(PERIODS(T):PUB_KJ_EXP(K,J,T)*((CO2_TRENP+2*CO2_TREN+CO2_TRENO)/4)*PD_KJ(K,J)))
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+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T)*D_JL(J,L)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))+@SUM(SEMI_I
NTERMODAL_EXP(L,J,I,T):Y_EXP(L,J,I,T)*D_LJ(L,J)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T)*D_KL(K,L)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))+@SUM(INTERMO
DAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T)*D_LK(L,K)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_IMP(I,L,T)*D_IL(I,L)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO
)/4))))
+@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):@SUM(PERIODS(T):X_EXP(L,I,T)*D_LI(L,I)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO
)/4))))
+@SUM(SHIPPMENT_IMP(I,L,T):SP_IMP(I,L,T)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)*D_IL(I,L)*((Rate_KP+2*Rate_K+Ra
te_KO)/4))
+@SUM(SHIPPMENT_EXP(L,I,T):SP_EXP(L,I,T)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)*D_LI(L,I)*((Rate_KP+2*Rate_K+Ra
te_KO)/4))
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)*DS_I
J(I,J)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4)))
+@SUM(SHIPPMENT_IMP(I,L,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_IMP(I,L,T)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)*D
_JL(J,L)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)*DS_J
I(J,I)*((CO2_DENIZP+2*CO2_DENIZ+CO2_DENIZO)/4)))
+@SUM(SHIPPMENT_EXP(L,I,T):@SUM(RORO_TERMINALS(J)|J#EQ#2:SP_EXP(L,I,T)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)*D
_LJ(L,J)*((Rate_KDP+2*Rate_KD+Rate_KDO)/4)))
+@SUM(RE_JL(J,L,T):REP_JL(J,L,T)*D_JL(J,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_LJ(L,J,T):REP_LJ(L,J,T)
*D_LJ(L,J)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_KL(K,L,T):REP_KL(K,L,T)*D_KL(K,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_LK(L,K,T):REP_LK(L,K,T)
*D_LK(L,K)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_LI(L,I,T):REP_LIE(L,I,T)*D_LI(L,I)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_IL(I,L,T):REP_ILE(I,L,
T)*D_IL(I,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_LI(L,I,T):REP_LIT(L,I,T)*D_LI(L,I)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_IL(I,L,T):REP_ILT(I,L,
T)*D_IL(I,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_IL(I,L,T):ST_IL(I,L,T)*D_IL(I,L)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))+@SUM(RE_LI(L,I,T):ST_LI(L,I,T
)*D_LI(L,I)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(RE_JK(J,K,T):V_JK(J,K,T)*D_JK(J,K)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_KJ(K,J,T):V_KJ(K,J,T)*D_K
J(K,J)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(REPOSITION_J(J,N,T):V_JJ(J,N,T)*D_JJ(J,N)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_JL(J,L,T):VV_JL(J,
L,T)*D_JL(J,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_LJ(L,J,T):VV_LJ(L,J,T)*D_LJ(L,J)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(REPOSITION_L(L,C,T):V_LL(L,
C,T)*D_LL(L,C)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(REPOSITION_I(I,D,T):V_II(I,D,T)*D_II(I,D)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_KL(K,L,T):VV_KL(K,
L,T)*D_KL(K,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_LK(L,K,T):VV_LK(L,K,T)*D_LK(L,K)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(REPOSITION_K(K,B,T):V_KK(K,
B,T)*D_KK(K,B)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_IL(I,L,T):EXREP_ILE(I,L,T)*D_IL(I,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_LI(L,I,T):EXREP_LIE(
L,I,T)*D_LI(L,I)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_IL(I,L,T):EXREP_ILT(I,L,T)*D_IL(I,L)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))+@SUM(RE_LI(L,I,T):EXREP_LIT(
L,I,T)*D_LI(L,I)*((CO2_REPP+2*CO2_REP+CO2_REPO)/4))
+@SUM(RE_IL(I,L,T):EXST_IL(I,L,T)*D_IL(I,L)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))+@SUM(RE_LI(L,I,T):EXST_LI(L
,I,T)*D_LI(L,I)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(REPOSITION_I(I,D,T):ST_II(I,D,T)*D_II(I,D)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))+@SUM(REPOSITION_L(L,C,
T):ST_LL(L,C,T)*D_LL(L,C)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4))
+@SUM(REPOSITION_L(L,C,T):TT_LL(L,C,T)*D_LL(L,C)*((CO2_KARAP+2*CO2_KARA+CO2_KARAO)/4)));

!CONSTRAINT SET;
!****MODEL COMPONENT-I: MULTI-MODE LOAD PLANNING OR INTERMODAL FREIGHT TRANSPORTATION PLANNING***

! Periodic load allocation to different modes of transport in order to satisfy probabilistic import/export
transport demands of order countries:
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):[IMPORT]X_IMP(I,L,T)+@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y
_IMP(I,J,L,T))+@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T))+SP_IMP(I,L,T)>=DE_IMP(I,L,T);
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):[EXPORT]X_EXP(L,I,T)+@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y
_EXP(L,J,I,T))+@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T))+SP_EXP(L,I,T)>=DE_EXP(L,I,T);))));
! Chance-constraint based Stochastic Programming ;
!Random transport demand setting from normal distribution;
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):@SPSTGRNDV(1,DE_IMP(I,L,T)))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):@SPSTGRNDV(1,DE_EXP(L,I,T)))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):@SPDISTNORM(DE_IMP_MU(I,L,T),DE_IMP_STD(I,L,T),DE_IMP(I,
L,T)))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):@SPDISTNORM(DE_EXP_MU(L,I,T),DE_EXP_STD(L,I,T),DE_EXP(L,
I,T)))));
! Chance- constraints' name;
@SPCHANCE('CCP_IMP','>=',Prb1);
@SPCHANCE('CCP_EXP','>=',Prb2);
! Assignment of chance-constraints;
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):
@SPCHANCE('CCP_IMP',IMPORT);
@SPCHANCE('CCP_EXP',EXPORT);
)));
! Determination of sample size;
@SPSAMPSIZE(1,NSAMP);
!--------------------The Specific Constraints On Marine Transportation Services----------------;
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@FOR(RORO_TERMINALS(J)|J#EQ#1:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_IMP(I,J,L,T))<=al
pha*((N_IMP(I,J,T)+N_IMPP(I,J,T))/2)*((CAP_RORO_IMP(I,J)+
CAP_RORO_IMPP(I,J))/2)+(1-alpha)*((N_IMP(I,J,T)+N_IMPO(I,J,T))/2)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPO(I,J))/2)-
@SUM(RORO_TERMINALS(J)|J#EQ#2:@SUM(DESTINATIONS(L):Y_IMP(I,J,L,T)))-
@SUM(INTERMODAL_IMP(I,J,K,L,T)|J#EQ#2:Z_IMP(I,J,K,L,T)))));
@FOR(RORO_TERMINALS(J)|J#EQ#1:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_EXP(L,J,I,T))<=al
pha*((N_EXP(J,I,T)+N_EXPP(J,I,T))/2)*((CAP_RORO_EXP(J,I)+
CAP_RORO_EXPP(J,I))/2)+(1-alpha)*((N_EXP(J,I,T)+N_EXPO(J,I,T))/2)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPO(J,I))/2)-
@SUM(RORO_TERMINALS(N)|J#EQ#2:@SUM(DESTINATIONS(L):Y_EXP(L,N,I,T)))-
@SUM(INTERMODAL_EXP(L,K,J,I,T)|J#EQ#2:Z_EXP(L,K,J,I,T)))));
@FOR(RORO_TERMINALS(J)|J#EQ#3:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#2:@SUM(DESTINATIONS(L):Y_IMP(I,J,L,T))<=al
pha*((N_IMP(I,J,T)+N_IMPP(I,J,T))/2)*((CAP_RORO_IMP(I,J)+
CAP_RORO_IMPP(I,J))/2)+(1-
alpha)*((N_IMP(I,J,T)+N_IMPO(I,J,T))/2)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPO(I,J))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#3:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#2:@SUM(DESTINATIONS(L):Y_EXP(L,J,I,T))<=al
pha*((N_EXP(J,I,T)+N_EXPP(J,I,T))/2)*((CAP_RORO_EXP(J,I)+
CAP_RORO_EXPP(J,I))/2)+(1-
alpha)*((N_EXP(J,I,T)+N_EXPO(J,I,T))/2)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPO(J,I))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#1:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_IMP(I,J,L,T))=OWN
_IMP(I,J,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#3:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#2:@SUM(DESTINATIONS(L):Y_IMP(I,J,L,T))=OWN
_IMP(I,J,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#1:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_EXP(L,J,I,T))=OWN
_EXP(J,I,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#3:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#2:@SUM(DESTINATIONS(L):Y_EXP(L,J,I,T))=OWN
_EXP(J,I,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_IMP(I,J,L,T))+@SU
M(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T))<=
(alpha*((N_IMP(I,J,T)+N_IMPP(I,J,T))/2)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPP(I,J))/2)+(1-
alpha)*((N_IMP(I,J,T)+N_IMPO(I,J,T))/2)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPO(I,J))/2)-
@SUM(DESTINATIONS(L):@SUM(RORO_TERMINALS(J)|J#EQ#1:Y_IMP(I,J,L,T))))+PUB_IJ_IMP(I,J,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_EXP(L,J,I,T))+@SU
M(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T))<=
(alpha*((N_EXP(J,I,T)+N_EXPP(J,I,T))/2)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPP(J,I))/2)+(1-
alpha)*((N_EXP(J,I,T)+N_EXPO(J,I,T))/2)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPO(J,I))/2)-
@SUM(DESTINATIONS(L):@SUM(RORO_TERMINALS(J)|J#EQ#1:Y_EXP(L,J,I,T))))+PUB_JI_EXP(J,I,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_IMP(I,J,L,T))+@SU
M(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T))=OWN_IMP(I,J,T)+PUB_IJ_IMP(I,J,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_EXP(L,J,I,T))+@SU
M(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T))=OWN_EXP(J,I,T)+PUB_JI_EXP(J,I,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#GT#1:@SUM(DESTINATIONS(L):Y_IMP(I,J,L,T))+@SU
M(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T))<=PUB_IJ_IMP(I,J,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#GT#1:@SUM(DESTINATIONS(L):Y_EXP(L,J,I,T))+@SU
M(INTERMODAL_IMP(L,K,J,I,T):Z_EXP(L,K,J,I,T))<=PUB_JI_EXP(J,I,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#4:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_IMP(I,J,L,T))<=PU
B_IJ_IMP(I,J,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#4:@FOR(PERIODS(T):@FOR(ORIGINS(I)|I#EQ#1:@SUM(DESTINATIONS(L):Y_EXP(L,J,I,T))<=PU
B_JI_EXP(J,I,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T):@SUM(RORO_TERMINALS(J)|J#EQ#1:OWN_IMP(I,
J,T))+OWN_IMP(I,J,T)<=(alpha/2)*SIJ_IMP(I,J,T)*
((CAP_RORO_IMP(I,J)+CAP_RORO_IMPP(I,J))/2)+(1-
(alpha/2))*SIJ_IMP(I,J,T)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPO(I,J))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T):@SUM(RORO_TERMINALS(J)|J#EQ#1:OWN_IMP(I,
J,T))+OWN_IMP(I,J,T)>=(1-(alpha/2))*SIJ_IMP(I,J,T)*
((CAP_RORO_IMP(I,J)+CAP_RORO_IMPP(I,J))/2)+(alpha/2)*SIJ_IMP(I,J,T)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPO(I,J))/2
))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T):@SUM(RORO_TERMINALS(J)|J#EQ#1:OWN_EXP(J,
I,T))+OWN_EXP(J,I,T)<=(alpha/2)*SJI_EXP(J,I,T)*
((CAP_RORO_EXP(J,I)+CAP_RORO_EXPP(J,I))/2)+(1-
(alpha/2))*SJI_EXP(J,I,T)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPO(J,I))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T):@SUM(RORO_TERMINALS(J)|J#EQ#1:OWN_EXP(J,
I,T))+OWN_EXP(J,I,T)>=(1-(alpha/2))*SJI_EXP(J,I,T)*
((CAP_RORO_EXP(J,I)+CAP_RORO_EXPP(J,I))/2)+(alpha/2)*SJI_EXP(J,I,T)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPO(J,I))/2
))));
@FOR(RORO_TERMINALS(J)|J#EQ#3:@FOR(ORIGINS(I)|I#EQ#2:@FOR(PERIODS(T):OWN_IMP(I,J,T)<=(alpha/2)*SIJ_IMP(I,J,T)
*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPP(I,J))/2)+
(1-(alpha/2))*SIJ_IMP(I,J,T)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPO(I,J))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#3:@FOR(ORIGINS(I)|I#EQ#2:@FOR(PERIODS(T):OWN_IMP(I,J,T)>=(1-
(alpha/2))*SIJ_IMP(I,J,T)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPP(I,J))/2)+
(alpha/2)*SIJ_IMP(I,J,T)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPO(I,J))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#3:@FOR(ORIGINS(I)|I#EQ#2:@FOR(PERIODS(T):OWN_EXP(J,I,T)<=(alpha/2)*SJI_EXP(J,I,T)
*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPP(J,I))/2)+(1-(alpha/2))*
SJI_EXP(J,I,T)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPO(J,I))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#3:@FOR(ORIGINS(I)|I#EQ#2:@FOR(PERIODS(T):OWN_EXP(J,I,T)>=(1-
(alpha/2))*SJI_EXP(J,I,T)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPP(J,I))/2)+(alpha/2)*
SJI_EXP(J,I,T)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPO(J,I))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#1:@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T):OWN_IMP(I,J,T)<=(alpha/2)*SIJ_IMP(I,J,T)
*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPP(I,J))/2)+(1-(alpha/2))*
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SIJ_IMP(I,J,T)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPO(I,J))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#1:@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T):OWN_IMP(I,J,T)>=(1-
(alpha/2))*SIJ_IMP(I,J,T)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPP(I,J))/2)+(alpha/2)*
SIJ_IMP(I,J,T)*((CAP_RORO_IMP(I,J)+CAP_RORO_IMPO(I,J))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#1:@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T):OWN_EXP(J,I,T)<=(alpha/2)*SJI_EXP(J,I,T)
*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPP(J,I))/2)+(1-(alpha/2))*
SJI_EXP(J,I,T)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPO(J,I))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#1:@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T):OWN_EXP(J,I,T)>=(1-
(alpha/2))*SJI_EXP(J,I,T)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPP(J,I))/2)+(alpha/2)*
SJI_EXP(J,I,T)*((CAP_RORO_EXP(J,I)+CAP_RORO_EXPO(J,I))/2))));
@FOR(SHIPPMENT_IJ_IMP11(I,J,T):SIJ_IMP(I,J,T)<=(alpha/2)*UTI_IMP(I,J,T)*((N_IMP(I,J,T)+N_IMPP(I,J,T))/2)+(1-
(alpha/2))*UTI_IMP(I,J,T)*((N_IMP(I,J,T)+N_IMPO(I,J,T))/2));
@FOR(SHIPPMENT_IJ_IMP11(I,J,T):SIJ_IMP(I,J,T)>=(1-
(alpha/2))*UTI_IMP(I,J,T)*((N_IMP(I,J,T)+N_IMPP(I,J,T))/2)+(alpha/2)*UTI_IMP(I,J,T)*((N_IMP(I,J,T)+N_IMPO(I,J
,T))/2));
@FOR(SHIPPMENT_JI_EXP11(J,I,T):SJI_EXP(J,I,T)>=(alpha/2)*UTI_EXP(J,I,T)*((N_EXP(J,I,T)+N_EXPO(J,I,T))/2)+(1-
(alpha/2))*UTI_EXP(J,I,T)*((N_EXP(J,I,T)+N_EXPP(J,I,T))/2));
@FOR(SHIPPMENT_JI_EXP11(J,I,T):SJI_EXP(J,I,T)<=(1-
(alpha/2))*UTI_EXP(J,I,T)*((N_EXP(J,I,T)+N_EXPO(J,I,T))/2)+(alpha/2)*UTI_EXP(J,I,T)*((N_EXP(J,I,T)+N_EXPP(J,I
,T))/2));
!----------------The Specific Constraints On Railway Transportation Services------------------;
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|(K#LE#3)#AND#(K#NE#2):@FOR(PERIODS(T):@SUM(DESTINATIONS
(L):@SUM(ORIGINS(I):Z_IMP(I,J,K,L,T)))<=alpha*SJK_IMP(J,K,T)*
((CAP_TRAIN_IMP(J,K)+CAP_TRAIN_IMPP(J,K))/2)+(1-
alpha)*SJK_IMP(J,K,T)*((CAP_TRAIN_IMP(J,K)+CAP_TRAIN_IMPO(J,K))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|(K#LE#3)#AND#(K#NE#2):@FOR(PERIODS(T):@SUM(DESTINATIONS
(L):@SUM(ORIGINS(I):Z_EXP(L,K,J,I,T)))<=alpha*SKJ_EXP(K,J,T)*
((CAP_TRAIN_EXP(K,J)+CAP_TRAIN_EXPP(K,J))/2)+(1-
alpha)*SKJ_EXP(K,J,T)*((CAP_TRAIN_EXP(K,J)+CAP_TRAIN_EXPO(K,J))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|K#EQ#2:@FOR(PERIODS(T):@SUM(DESTINATIONS(L):@SUM(ORIGIN
S(I):Z_IMP(I,J,K,L,T)))<=PUB_JK_IMP(J,K,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|K#EQ#2:@FOR(PERIODS(T):@SUM(DESTINATIONS(L):@SUM(ORIGIN
S(I):Z_EXP(L,K,J,I,T)))<=PUB_KJ_EXP(K,J,T))));
@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(S)|S#EQ#4:@FOR(RORO_TERMINALS(J)|J#EQ#2:@SUM(DESTINATIONS(L):@SUM(ORIGIN
S(I):Z_IMP(I,J,S,L,T)))+@SUM(DESTINATIONS(L):@SUM(ORIGINS(I):
@SUM(TRAIN_TERMINALS(K)|K#GE#5:Z_IMP(I,J,K,L,T))))<=alpha*SJK_IMP(J,S,T)*((CAP_TRAIN_IMP(J,S)+CAP_TRAIN_IMPP(
J,S))/2)+
(1-alpha)*SJK_IMP(J,S,T)*((CAP_TRAIN_IMP(J,S)+CAP_TRAIN_IMPO(J,S))/2))));
@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(S)|S#EQ#4:@FOR(RORO_TERMINALS(J)|J#EQ#2:@SUM(DESTINATIONS(L):@SUM(ORIGIN
S(I):Z_EXP(L,S,J,I,T)))+@SUM(DESTINATIONS(L):@SUM(ORIGINS(I):
@SUM(TRAIN_TERMINALS(K)|K#GE#5:Z_EXP(L,K,J,I,T))))<=alpha*SKJ_EXP(S,J,T)*((CAP_TRAIN_EXP(S,J)+CAP_TRAIN_EXPP(
S,J))/2)+
(1-alpha)*SKJ_EXP(S,J,T)*((CAP_TRAIN_EXP(S,J)+CAP_TRAIN_EXPO(S,J))/2))));
@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K)|K#GE#5:@FOR(TRAIN_TERMINALS(S)|S#EQ#4:@SUM(ORIGINS(I):@SUM(DESTINATIO
NS(L):@SUM(RORO_TERMINALS(J)|J#EQ#2:Z_IMP(I,J,K,L,T))))<=PUB_SK_IMP(S,K,T))));
@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K)|K#GE#5:@FOR(TRAIN_TERMINALS(S)|S#EQ#4:@SUM(ORIGINS(I):@SUM(DESTINATIO
NS(L):@SUM(RORO_TERMINALS(J)|J#EQ#2:Z_EXP(L,K,J,I,T))))<=PUB_KS_EXP(K,S,T))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|(K#LE#4)#AND#(K#NE#2):@FOR(PERIODS(T):SJK_IMP(J,K,T)<=a
lpha*((M_IMP(J,K,T)+M_IMPP(J,K,T))/2)+(1-alpha)*((M_IMP(J,K,T)+M_IMPO(J,K,T))/2))));!;
@FOR(TRAIN_TERMINALS(K)|(K#LE#4)#AND#(K#NE#2):@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(PERIODS(T):SKJ_EXP(K,J,T)<=a
lpha*((M_EXP(K,J,T)+M_EXPP(K,J,T))/2)+(1-alpha)*((M_EXP(K,J,T)+M_EXPO(K,J,T))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|(K#LE#4)#AND#(K#NE#2):@FOR(PERIODS(T):SJK_IMP(J,K,T)>=(
1-alpha)*((MU_IMP(J,K)+MU_IMPP(J,K))/2)+alpha*((MU_IMP(J,K)+MU_IMPO(J,K))/2))));
@FOR(TRAIN_TERMINALS(K)|(K#LE#4)#AND#(K#NE#2):@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(PERIODS(T):SKJ_EXP(K,J,T)>=(
1-alpha)*((MU_EXP(K,J)+MU_EXPP(K,J))/2)+alpha*
((MU_EXP(K,J)+MU_EXPO(K,J))/2))));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|(K#LE#4)#AND#(K#NE#2):@FOR(PERIODS(T):SJK_IMP(J,K,T)-
SKJ_EXP(K,J,T)<=1)));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|(K#LE#4)#AND#(K#NE#2):@FOR(PERIODS(T):SKJ_EXP(K,J,T)-
SJK_IMP(J,K,T)<=1)));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|(K#LE#4)#AND#(K#NE#2):@SUM(PERIODS(T):SJK_IMP(J,K,T)-
SKJ_EXP(K,J,T))<=1));
@FOR(RORO_TERMINALS(J)|J#EQ#2:@FOR(TRAIN_TERMINALS(K)|(K#LE#4)#AND#(K#NE#2):@SUM(PERIODS(T):SKJ_EXP(K,J,T)-
SJK_IMP(J,K,T))<=1));
@FOR(PERIODS(T):@FOR(MARIRAILLINK1(I,J,K)|K#GE#5:@FOR(DESTINATIONS(L)|L#NE#27#AND#L#NE#33#AND#L#NE#34#AND#L#N
E#37:Z_IMP(I,J,K,L,T)<=0)));
@FOR(PERIODS(T):@FOR(MARIRAILLINK2(K,J,I)|K#GE#5:@FOR(DESTINATIONS(L)|L#NE#27#AND#L#NE#33#AND#L#NE#34#AND#L#N
E#37:Z_EXP(L,K,J,I,T)<=0)));
@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K)|K#GE#5:@FOR(DESTINATIONS(L)|L#NE#27#AND#L#NE#33#AND#L#NE#34#AND#L#NE#
37:V_LK(L,K,T)<=0)));
@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K)|K#GE#5:@FOR(DESTINATIONS(L)|L#NE#27#AND#L#NE#33#AND#L#NE#34#AND#L#NE#
37:V_KL(K,L,T)<=0)));
@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K)|K#GE#5:@FOR(DESTINATIONS(L)|L#NE#27#AND#L#NE#33#AND#L#NE#34#AND#L#NE#
37:VEC_LK(L,K,T)<=0)));
@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K)|K#GE#5:@FOR(DESTINATIONS(L)|L#NE#27#AND#L#NE#33#AND#L#NE#34#AND#L#NE#
37:VEC_KL(K,L,T)<=0)));
@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K)|K#GE#5:@FOR(DESTINATIONS(L)|L#NE#27#AND#L#NE#33#AND#L#NE#34#AND#L#NE#
37:REP_LK(L,K,T)<=0)));
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@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K)|K#GE#5:@FOR(DESTINATIONS(L)|L#NE#27#AND#L#NE#33#AND#L#NE#34#AND#L#NE#
37:REP_KL(K,L,T)<=0)));
!********MODEL COMPONENT-II: TRUCK & TRAILER FLEET SIZE OPTIMIZATION AND FLEET ALLOCATION*******;
!---------------Connections Between Load Plans And Loaded Truck Movements---------------:
@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):@SUM(SEMI_INTERMODAL_IMP(I,J,L,T):Y_IMP(I,J,L,T))
=V_JL(J,L,T))));
@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):@SUM(INTERMODAL_IMP(I,J,K,L,T):Z_IMP(I,J,K,L,T))
=V_KL(K,L,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):X_EXP(L,I,T)=V_LIE(L,I,T)+V_LIT(L,I,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(RORO_TERMINALS(J):@SUM(SEMI_INTERMODAL_EXP(L,J,I,T):Y_EXP(L,J,I,T))
=V_LJ(L,J,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K):@SUM(INTERMODAL_EXP(L,K,J,I,T):Z_EXP(L,K,J,I,T))
=V_LK(L,K,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):X_IMP(I,L,T)=V_ILE(I,L,T)+V_ILT(I,L,T))));
!-------------The Minimum Number Of European And Turkish Plated Truck Fleet Sizes--------------;
@FOR(RORO_TERMINALS(J):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):(VEC_JL(J,L,T)+VEC_LJ(L,J,T))*(alpha*((WOH(L,T)+W
OHP(L,T))/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVE+AVEP)/2)+(1-alpha)*((AVE+AVEO)/2))>=(V_JL(J,L,T)*(((1-alpha)*(T_JL(J,L)+T_JLP(J,L))/2)+alpha*
(T_JL(J,L)+T_JLO(J,L))/2)+V_LJ(L,J,T)*(((1-
alpha)*(T_LJ(L,J)+T_LJP(L,J))/2)+alpha*(T_LJ(L,J)+T_LJO(L,J))/2))+(V_JL(J,L,T)*(((1-
alpha)*(T_JL(J,L)+T_JLP(J,L))/2)+alpha*
(T_JL(J,L)+T_JLO(J,L))/2)-V_LJ(L,J,T)*(((1-
alpha)*(T_LJ(L,J)+T_LJP(L,J))/2)+alpha*(T_LJ(L,J)+T_LJO(L,J))/2)))));
@FOR(RORO_TERMINALS(J):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):(VEC_JL(J,L,T)+VEC_LJ(L,J,T))*(alpha*((WOH(L,T)+W
OHP(L,T))/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVE+AVEP)/2)+(1-alpha)*((AVE+AVEO)/2))>=(V_JL(J,L,T)*(((1-alpha)*(T_JL(J,L)+T_JLP(J,L))/2)+alpha*
(T_JL(J,L)+T_JLO(J,L))/2)+V_LJ(L,J,T)*(((1-
alpha)*(T_LJ(L,J)+T_LJP(L,J))/2)+alpha*(T_LJ(L,J)+T_LJO(L,J))/2))+(V_LJ(L,J,T)*(((1-
alpha)*(T_LJ(L,J)+T_LJP(L,J))/2)+
alpha*(T_LJ(L,J)+T_LJO(L,J))/2)-V_JL(J,L,T)*(((1-
alpha)*(T_JL(J,L)+T_JLP(J,L))/2)+alpha*(T_JL(J,L)+T_JLO(J,L))/2)))));
@FOR(TRAIN_TERMINALS(K):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):(VEC_KL(K,L,T)+VEC_LK(L,K,T))*(alpha*((WOH(L,T)+
WOHP(L,T))/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVE+AVEP)/2)+(1-alpha)*((AVE+AVEO)/2))>=(V_KL(K,L,T)*(((1-alpha)*(T_KL(K,L)+T_KLP(K,L))/2)+alpha*
(T_KL(K,L)+T_KLO(K,L))/2)+V_LK(L,K,T)*(((1-
alpha)*(T_LK(L,K)+T_LKP(L,K))/2)+alpha*(T_LK(L,K)+T_LKO(L,K))/2))+(V_KL(K,L,T)*(((1-
alpha)*(T_KL(K,L)+T_KLP(K,L))/2)+alpha*
(T_KL(K,L)+T_KLO(K,L))/2)-V_LK(L,K,T)*(((1-
alpha)*(T_LK(L,K)+T_LKP(L,K))/2)+alpha*(T_LK(L,K)+T_LKO(L,K))/2)))));
@FOR(TRAIN_TERMINALS(K):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):(VEC_KL(K,L,T)+VEC_LK(L,K,T))*(alpha*((WOH(L,T)+
WOHP(L,T))/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVE+AVEP)/2)+(1-alpha)*((AVE+AVEO)/2))>=(V_KL(K,L,T)*(((1-alpha)*(T_KL(K,L)+T_KLP(K,L))/2)+alpha*
(T_KL(K,L)+T_KLO(K,L))/2)+V_LK(L,K,T)*(((1-
alpha)*(T_LK(L,K)+T_LKP(L,K))/2)+alpha*(T_LK(L,K)+T_LKO(L,K))/2))+(V_LK(L,K,T)*(((1-
alpha)*(T_LK(L,K)+T_LKP(L,K))/2)+
alpha*(T_LK(L,K)+T_LKO(L,K))/2)-V_KL(K,L,T)*(((1-
alpha)*(T_KL(K,L)+T_KLP(K,L))/2)+alpha*(T_KL(K,L)+T_KLO(K,L))/2)))));
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):(EP_IL(I,L,T)+EP_LI(L,I,T))*(alpha*((WOH(L,T)+WOHP(L,T))
/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVE+AVEP)/2)+(1-alpha)*((AVE+AVEO)/2))>=(V_ILE(I,L,T)*(((1-alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*
(T_IL(I,L)+T_ILO(I,L))/2)+V_LIE(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2))+(V_ILE(I,L,T)*(((1-
alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*
(T_IL(I,L)+T_ILO(I,L))/2)-V_LIE(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2)))));
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):(EP_IL(I,L,T)+EP_LI(L,I,T))*(alpha*((WOH(L,T)+WOHP(L,T))
/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVE+AVEP)/2)+(1-alpha)*((AVE+AVEO)/2))>=(V_ILE(I,L,T)*(((1-alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*
(T_IL(I,L)+T_ILO(I,L))/2)+V_LIE(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2))+(V_LIE(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+
T_LIO(L,I))/2)-V_ILE(I,L,T)*(((1-alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*(T_IL(I,L)+T_ILO(I,L))/2)))));
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):(TP_IL(I,L,T)+TP_LI(L,I,T))*(alpha*((WOH(L,T)+WOHP(L,T))
/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVT+AVTP)/2)+(1-alpha)*((AVT+AVTO)/2))>=(V_ILT(I,L,T)*(((1-alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*
(T_IL(I,L)+T_ILO(I,L))/2)+V_LIT(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2))+(V_ILT(I,L,T)*(((1-
alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*
(T_IL(I,L)+T_ILO(I,L))/2)-V_LIT(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2)))));
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):(TP_IL(I,L,T)+TP_LI(L,I,T))*(alpha*((WOH(L,T)+WOHP(L,T))
/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVT+AVTP)/2)+(1-alpha)*((AVT+AVTO)/2))>=(V_ILT(I,L,T)*(((1-alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*
(T_IL(I,L)+T_ILO(I,L))/2)+V_LIT(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2))+(V_LIT(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+
T_LIO(L,I))/2)-V_ILT(I,L,T)*(((1-alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*(T_IL(I,L)+T_ILO(I,L))/2)))));
@FOR(RORO_TERMINALS(J):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):VEC_JL(J,L,T)<=V_JL(J,L,T))));
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@FOR(RORO_TERMINALS(J):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):VEC_LJ(L,J,T)<=V_LJ(L,J,T))));
@FOR(TRAIN_TERMINALS(K):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):VEC_KL(K,L,T)<=V_KL(K,L,T))));
@FOR(TRAIN_TERMINALS(K):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):VEC_LK(L,K,T)<=V_LK(L,K,T))));
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):EP_IL(I,L,T)<=V_ILE(I,L,T))));
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):EP_LI(L,I,T)<=V_LIE(L,I,T))));
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):TP_IL(I,L,T)<=V_ILT(I,L,T))));
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):TP_LI(L,I,T)<=V_LIT(L,I,T))));
!------- The Minimum Number Of Trailer Fleet Size On The Overall Intermodal Logistics Network----;
@FOR(DESTINATIONS(L):@FOR(ORIGINS(I):@FOR(PERIODS(T):(TRAI_LI(L,I,T)+TRAI_IL(I,L,T))*(alpha*((WOH(L,T)+WOHP(L
,T))/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVD+AVDP)/2)+(1-alpha)*((AVD+AVDO)/2))>=(X_IMP(I,L,T)*(((1-
alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*(T_IL(I,L)+T_ILO(I,L))/2)+
@SUM(MARILINK1(I,J):Y_IMP(I,J,L,T)*((((1-
alpha)*(TT_IJ(I,J)+TT_IJP(I,J))/2)+alpha*(TT_IJ(I,J)+TT_IJO(I,J))/2)+(((1-
alpha)*(T_JL(J,L)+T_JLP(J,L))/2)+alpha*(T_JL(J,L)+T_JLO(J,L))/2)))+
@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T)*((((1-
alpha)*(TT_IJ(I,J)+TT_IJP(I,J))/2)+alpha*(TT_IJ(I,J)+TT_IJO(I,J))/2)+(((1-
alpha)*(TR_JK(J,K)+TR_JKP(J,K))/2)+alpha*(TR_JK(J,K)+TR_JKO(J,K))/2)+
(((1-alpha)*(T_KL(K,L)+T_KLP(K,L))/2)+alpha*(T_KL(K,L)+T_KLO(K,L))/2)))+X_EXP(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2)+
@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T)*((((1-
alpha)*(TT_JI(J,I)+TT_JIP(J,I))/2)+alpha*(TT_JI(J,I)+TT_JIO(J,I))/2)+(((1-
alpha)*(T_LJ(L,J)+T_LJP(L,J))/2)+alpha*(T_LJ(L,J)+T_LJO(L,J))/2)))+
@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)*((((1-
alpha)*(TT_JI(J,I)+TT_JIP(J,I))/2)+alpha*(TT_JI(J,I)+TT_JIO(J,I))/2)+(((1-
alpha)*(TR_KJ(K,J)+TR_KJP(K,J))/2)+alpha*(TR_KJ(K,J)+TR_KJO(K,J))/2)+
(((1-alpha)*(T_LK(L,K)+T_LKP(L,K))/2)+alpha*(T_LK(L,K)+T_LKO(L,K))/2))))+(X_IMP(I,L,T)*(((1-
alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*(T_IL(I,L)+T_ILO(I,L))/2)+
@SUM(MARILINK1(I,J):Y_IMP(I,J,L,T)*((((1-
alpha)*(TT_IJ(I,J)+TT_IJP(I,J))/2)+alpha*(TT_IJ(I,J)+TT_IJO(I,J))/2)+(((1-
alpha)*(T_JL(J,L)+T_JLP(J,L))/2)+alpha*(T_JL(J,L)+T_JLO(J,L))/2)))+
@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T)*((((1-
alpha)*(TT_IJ(I,J)+TT_IJP(I,J))/2)+alpha*(TT_IJ(I,J)+TT_IJO(I,J))/2)+(((1-
alpha)*(TR_JK(J,K)+TR_JKP(J,K))/2)+alpha*(TR_JK(J,K)+TR_JKO(J,K))/2)+
(((1-alpha)*(T_KL(K,L)+T_KLP(K,L))/2)+alpha*(T_KL(K,L)+T_KLO(K,L))/2)))-X_EXP(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2)-
@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T)*((((1-
alpha)*(TT_JI(J,I)+TT_JIP(J,I))/2)+alpha*(TT_JI(J,I)+TT_JIO(J,I))/2)+(((1-
alpha)*(T_LJ(L,J)+T_LJP(L,J))/2)+alpha*(T_LJ(L,J)+T_LJO(L,J))/2)))-
@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)*((((1-
alpha)*(TT_JI(J,I)+TT_JIP(J,I))/2)+alpha*(TT_JI(J,I)+TT_JIO(J,I))/2)+(((1-
alpha)*(TR_KJ(K,J)+TR_KJP(K,J))/2)+alpha*(TR_KJ(K,J)+TR_KJO(K,J))/2)+
(((1-alpha)*(T_LK(L,K)+T_LKP(L,K))/2)+alpha*(T_LK(L,K)+T_LKO(L,K))/2)))))));
!;@FOR(DESTINATIONS(L):@FOR(ORIGINS(I):@FOR(PERIODS(T):(TRAI_LI(L,I,T)+TRAI_IL(I,L,T))*(alpha*((WOH(L,T)+WOHP
(L,T))/2)+(1-alpha)*((WOH(L,T)+WOHO(L,T))/2))*HR*
(alpha*((AVD+AVDP)/2)+(1-alpha)*((AVD+AVDO)/2))>=(X_IMP(I,L,T)*(((1-
alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*(T_IL(I,L)+T_ILO(I,L))/2)+
@SUM(MARILINK1(I,J):Y_IMP(I,J,L,T)*((((1-
alpha)*(TT_IJ(I,J)+TT_IJP(I,J))/2)+alpha*(TT_IJ(I,J)+TT_IJO(I,J))/2)+(((1-
alpha)*(T_JL(J,L)+T_JLP(J,L))/2)+alpha*(T_JL(J,L)+T_JLO(J,L))/2)))+
@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T)*((((1-
alpha)*(TT_IJ(I,J)+TT_IJP(I,J))/2)+alpha*(TT_IJ(I,J)+TT_IJO(I,J))/2)+(((1-
alpha)*(TR_JK(J,K)+TR_JKP(J,K))/2)+alpha*(TR_JK(J,K)+TR_JKO(J,K))/2)+
(((1-alpha)*(T_KL(K,L)+T_KLP(K,L))/2)+alpha*(T_KL(K,L)+T_KLO(K,L))/2)))+X_EXP(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2)+
@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T)*((((1-
alpha)*(TT_JI(J,I)+TT_JIP(J,I))/2)+alpha*(TT_JI(J,I)+TT_JIO(J,I))/2)+(((1-
alpha)*(T_LJ(L,J)+T_LJP(L,J))/2)+alpha*(T_LJ(L,J)+T_LJO(L,J))/2)))+
@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)*((((1-
alpha)*(TT_JI(J,I)+TT_JIP(J,I))/2)+alpha*(TT_JI(J,I)+TT_JIO(J,I))/2)+(((1-
alpha)*(TR_KJ(K,J)+TR_KJP(K,J))/2)+alpha*(TR_KJ(K,J)+TR_KJO(K,J))/2)+
(((1-alpha)*(T_LK(L,K)+T_LKP(L,K))/2)+alpha*(T_LK(L,K)+T_LKO(L,K))/2))))+(X_EXP(L,I,T)*(((1-
alpha)*(T_LI(L,I)+T_LIP(L,I))/2)+alpha*(T_LI(L,I)+T_LIO(L,I))/2)+
@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T)*((((1-
alpha)*(TT_JI(J,I)+TT_JIP(J,I))/2)+alpha*(TT_JI(J,I)+TT_JIO(J,I))/2)+(((1-
alpha)*(T_LJ(L,J)+T_LJP(L,J))/2)+alpha*(T_LJ(L,J)+T_LJO(L,J))/2)))+
@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)*((((1-
alpha)*(TT_JI(J,I)+TT_JIP(J,I))/2)+alpha*(TT_JI(J,I)+TT_JIO(J,I))/2)+(((1-
alpha)*(TR_KJ(K,J)+TR_KJP(K,J))/2)+alpha*(TR_KJ(K,J)+TR_KJO(K,J))/2)+
(((1-alpha)*(T_LK(L,K)+T_LKP(L,K))/2)+alpha*(T_LK(L,K)+T_LKO(L,K))/2)))-X_IMP(I,L,T)*(((1-
alpha)*(T_IL(I,L)+T_ILP(I,L))/2)+alpha*(T_IL(I,L)+T_ILO(I,L))/2)-
@SUM(MARILINK1(I,J):Y_IMP(I,J,L,T)*((((1-
alpha)*(TT_IJ(I,J)+TT_IJP(I,J))/2)+alpha*(TT_IJ(I,J)+TT_IJO(I,J))/2)+(((1-
alpha)*(T_JL(J,L)+T_JLP(J,L))/2)+alpha*(T_JL(J,L)+T_JLO(J,L))/2)))-
@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T)*((((1-
alpha)*(TT_IJ(I,J)+TT_IJP(I,J))/2)+alpha*(TT_IJ(I,J)+TT_IJO(I,J))/2)+(((1-
alpha)*(TR_JK(J,K)+TR_JKP(J,K))/2)+alpha*(TR_JK(J,K)+TR_JKO(J,K))/2)+
(((1-alpha)*(T_KL(K,L)+T_KLP(K,L))/2)+alpha*(T_KL(K,L)+T_KLO(K,L))/2)))))));
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!------Logical constraints for relationship between loaded trailer movements & fleet sizes:-----;
@FOR(DESTINATIONS(L):@FOR(ORIGINS(I):@FOR(PERIODS(T):TRAI_LI(L,I,T)<=X_EXP(L,I,T)+@SUM(MARILINK2(J,I):Y_EXP(L
,J,I,T))+@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)))));
@FOR(DESTINATIONS(L):@FOR(ORIGINS(I):@FOR(PERIODS(T):TRAI_IL(I,L,T)<=X_IMP(I,L,T)+@SUM(MARILINK1(I,J):Y_IMP(I
,J,L,T))+@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T)))));
!-------------The internal empty truck repositioning constraints ------------------------------;
@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):REP_LJ(L,J,T)>=V_JL(J,L,T)-V_LJ(L,J,T)-
VEC_JL(J,L,T))));
@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):REP_LK(L,K,T)>=V_KL(K,L,T)-V_LK(L,K,T)-
VEC_KL(K,L,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(TRAIN_TERMINALS(K):REP_KL(K,L,T)>=V_LK(L,K,T)-V_KL(K,L,T)-
VEC_LK(L,K,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(RORO_TERMINALS(J):REP_JL(J,L,T)>=V_LJ(L,J,T)-V_JL(J,L,T)-
VEC_LJ(L,J,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):REP_LIE(L,I,T)>=V_ILE(I,L,T)-V_LIE(L,I,T)-
EP_IL(I,L,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):REP_ILE(I,L,T)>=V_LIE(L,I,T)-V_ILE(I,L,T)-
EP_LI(L,I,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):REP_LIT(L,I,T)>=V_ILT(I,L,T)-V_LIT(L,I,T)-
TP_IL(I,L,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):REP_ILT(I,L,T)>=V_LIT(L,I,T)-V_ILT(I,L,T)-
TP_LI(L,I,T))));
!-------------The internal empty trailer repositioning constraints----------------------------;
@FOR(ORIGINS(I):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):ST_LI(L,I,T)>=X_IMP(I,L,T)+@SUM(MARILINK1(I,J):Y_IMP(I,J
,L,T))+@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T))-
X_EXP(L,I,T)-@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T))-@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T))-TRAI_IL(I,L,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):ST_IL(I,L,T)>=X_EXP(L,I,T)+@SUM(MARILINK2(J,I):Y_EXP(L,J
,I,T))+@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T))-
X_IMP(I,L,T)-@SUM(MARILINK1(I,J):Y_IMP(I,J,L,T))-@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T))-TRAI_LI(L,I,T))));
!-----Logical constraints for relationship between internal empty truck/ trailer repositioning--;
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):REP_ILT(I,L,T)+REP_ILE(I,L,T)>=ST_IL(I,L,T))));
@FOR(ORIGINS(I):@FOR(DESTINATIONS(L):@FOR(PERIODS(T):REP_LIT(L,I,T)+REP_LIE(L,I,T)>=ST_LI(L,I,T))));
!-----------------------------------CURRENT CONDITIONS-----------------------------------------;
@FOR(PERIODS(T)|T#EQ#1:@SUM(RORO_TERMINALS(J):@SUM(DESTINATIONS(L):VEC_JL(J,L,T)))+@SUM(TRAIN_TERMINALS(K):@S
UM(DESTINATIONS(L):VEC_KL(K,L,T)))+
@SUM(DESTINATIONS(L):@SUM(RORO_TERMINALS(J):VEC_LJ(L,J,T)))+@SUM(DESTINATIONS(L):@SUM(TRAIN_TERMINALS(K):VEC_
LK(L,K,T)))+@SUM(DESTINATIONS(L):@SUM(ORIGINS(I):EP_LI(L,I,T)))+
@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):EP_IL(I,L,T)))<=@SUM(ORIGINS(I):V_IE0(I))+@SUM(RORO_TERMINALS(J):V_J0(J)
)+@SUM(TRAIN_TERMINALS(K):V_K0(K))+@SUM(DESTINATIONS(L):V_LE0(L)));
@FOR(PERIODS(T)|T#GT#1:@SUM(RORO_TERMINALS(J):@SUM(DESTINATIONS(L):VEC_JL(J,L,T)))+@SUM(TRAIN_TERMINALS(K):@S
UM(DESTINATIONS(L):VEC_KL(K,L,T)))+
@SUM(DESTINATIONS(L):@SUM(RORO_TERMINALS(J):VEC_LJ(L,J,T)))+@SUM(DESTINATIONS(L):@SUM(TRAIN_TERMINALS(K):VEC_
LK(L,K,T)))+@SUM(DESTINATIONS(L):@SUM(ORIGINS(I):EP_LI(L,I,T)))+
@SUM(ORIGINS(I):@SUM(DESTINATIONS(L):EP_IL(I,L,T)))<=@SUM(RORO_TERMINALS(J):V_J(J,T-
1))+@SUM(TRAIN_TERMINALS(K):V_K(K,T-1))+@SUM(DESTINATIONS(L):V_LE(L,T-1))+@SUM(ORIGINS(I):V_IE(I,T-1)));
@FOR(PERIODS(T)|T#EQ#1:@SUM(DESTINATIONS(L):@SUM(ORIGINS(I):TP_LI(L,I,T)))+@SUM(ORIGINS(I):@SUM(DESTINATIONS(
L):TP_IL(I,L,T)))<=@SUM(ORIGINS(I):V_IT0(I))+
@SUM(DESTINATIONS(L):V_LT0(L)));
@FOR(PERIODS(T)|T#GT#1:@SUM(DESTINATIONS(L):@SUM(ORIGINS(I):TP_LI(L,I,T)))+@SUM(ORIGINS(I):@SUM(DESTINATIONS(
L):TP_IL(I,L,T)))<=@SUM(DESTINATIONS(L):V_LT(L,T-1))+
@SUM(ORIGINS(I):V_IT(I,T-1)));
@FOR(PERIODS(T)|T#EQ#1:@SUM(DESTINATIONS(L):@SUM(ORIGINS(I):TRAI_LI(L,I,T)))+@SUM(ORIGINS(I):@SUM(DESTINATION
S(L):TRAI_IL(I,L,T)))<=@SUM(DESTINATIONS(L):ST_L0(L))+
@SUM(ORIGINS(I):ST_I0(I)));
!;@FOR(PERIODS(T)|T#GT#1:@SUM(DESTINATIONS(L):@SUM(ORIGINS(I):TRAI_LI(L,I,T)))+@SUM(ORIGINS(I):@SUM(DESTINATI
ONS(L):TRAI_IL(I,L,T)))<=@SUM(DESTINATIONS(L):ST_L(L,T-1))+
@SUM(ORIGINS(I):ST_I(I,T-1)));
!******MODEL COMPONENT - III: PERIODIC TRUCK & TRAILER INVENTORIES ON THE INTERMODAL LOGISTICS NETWORK AND
FLEET EXPANSION/REDUCTION DECISIONS*******;
!-------The periodic European & Turkish plated truck inventories at different locations:-------;
@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T)|T#EQ#1:V_J(J,T)=V_J0(J)-
@SUM(DESTINATIONS(L):V_JL(J,L,T))+@SUM(DESTINATIONS(L):V_LJ(L,J,T))-@SUM(DESTINATIONS(L):REP_JL(J,L,T))
+@SUM(DESTINATIONS(L):REP_LJ(L,J,T))+@SUM(RORO_TERMINALS(N)|N#NE#J:V_JJ(N,J,T))+@SUM(DESTINATIONS(L):VV_LJ(L,
J,T))+
@SUM(TRAIN_TERMINALS(K):V_KJ(K,J,T))-@SUM(RORO_TERMINALS(N)|N#NE#J:V_JJ(J,N,T))-
@SUM(DESTINATIONS(L):VV_JL(J,L,T))-@SUM(TRAIN_TERMINALS(K):V_JK(J,K,T))));
!;@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T)|T#GT#1:V_J(J,T)=V_J(J,T-1)-
@SUM(DESTINATIONS(L):V_JL(J,L,T))+@SUM(DESTINATIONS(L):V_LJ(L,J,T))-@SUM(DESTINATIONS(L):REP_JL(J,L,T))
+@SUM(DESTINATIONS(L):REP_LJ(L,J,T))+@SUM(RORO_TERMINALS(N)|N#NE#J:V_JJ(N,J,T))+@SUM(DESTINATIONS(L):VV_LJ(L,
J,T))+
@SUM(TRAIN_TERMINALS(K):V_KJ(K,J,T))-@SUM(RORO_TERMINALS(N)|N#NE#J:V_JJ(J,N,T))-
@SUM(DESTINATIONS(L):VV_JL(J,L,T))-@SUM(TRAIN_TERMINALS(K):V_JK(J,K,T))));
@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T)|T#EQ#1:V_K(K,T)=V_K0(K)+@SUM(DESTINATIONS(L):V_LK(L,K,T))-
@SUM(DESTINATIONS(L):V_KL(K,L,T))-@SUM(DESTINATIONS(L):REP_KL(K,L,T))
+@SUM(DESTINATIONS(L):REP_LK(L,K,T))+@SUM(TRAIN_TERMINALS(B)|B#NE#K:V_KK(B,K,T))+@SUM(RORO_TERMINALS(J):V_JK(
J,K,T))+@SUM(DESTINATIONS(L):VV_LK(L,K,T))-@SUM(DESTINATIONS(L):VV_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(B)|B#NE#K:V_KK(K,B,T))-@SUM(RORO_TERMINALS(J):V_KJ(K,J,T))));
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!;@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T)|T#GT#1:V_K(K,T)=V_K(K,T-1)+@SUM(DESTINATIONS(L):V_LK(L,K,T))-
@SUM(DESTINATIONS(L):V_KL(K,L,T))-@SUM(DESTINATIONS(L):REP_KL(K,L,T))
+@SUM(DESTINATIONS(L):REP_LK(L,K,T))+@SUM(TRAIN_TERMINALS(B)|B#NE#K:V_KK(B,K,T))+@SUM(RORO_TERMINALS(J):V_JK(
J,K,T))+@SUM(DESTINATIONS(L):VV_LK(L,K,T))-@SUM(DESTINATIONS(L):VV_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(B)|B#NE#K:V_KK(K,B,T))-@SUM(RORO_TERMINALS(J):V_KJ(K,J,T))));
@FOR(DESTINATIONS(L)|L#GT#10:@FOR(PERIODS(T)|T#EQ#1:V_LE(L,T)=V_LE0(L)+@SUM(RORO_TERMINALS(J):V_JL(J,L,T))-
@SUM(RORO_TERMINALS(J):V_LJ(L,J,T))+@SUM(TRAIN_TERMINALS(K):V_KL(K,L,T))
-@SUM(TRAIN_TERMINALS(K):V_LK(L,K,T))+@SUM(ORIGINS(I):V_ILE(I,L,T))-
@SUM(ORIGINS(I):V_LIE(L,I,T))+@SUM(RORO_TERMINALS(J):REP_JL(J,L,T))-@SUM(RORO_TERMINALS(J):REP_LJ(L,J,T))+
@SUM(TRAIN_TERMINALS(K):REP_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(K):REP_LK(L,K,T))+@SUM(ORIGINS(I):REP_ILE(I,L,T))-
@SUM(ORIGINS(I):REP_LIE(L,I,T))+@SUM(RORO_TERMINALS(J):VV_JL(J,L,T))+
@SUM(DESTINATIONS(C)|C#NE#L:V_LL(C,L,T))-@SUM(RORO_TERMINALS(J):VV_LJ(L,J,T))-
@SUM(DESTINATIONS(C)|C#NE#L:V_LL(L,C,T))+@SUM(TRAIN_TERMINALS(K):VV_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(K):VV_LK(L,K,T))+@SUM(ORIGINS(I):EXREP_ILE(I,L,T))-@SUM(ORIGINS(I):EXREP_LIE(L,I,T))));
!;@FOR(DESTINATIONS(L)|L#GT#10:@FOR(PERIODS(T)|T#GT#1:V_LE(L,T)=V_LE(L,T-
1)+@SUM(RORO_TERMINALS(J):V_JL(J,L,T))-
@SUM(RORO_TERMINALS(J):V_LJ(L,J,T))+@SUM(TRAIN_TERMINALS(K):V_KL(K,L,T))
-@SUM(TRAIN_TERMINALS(K):V_LK(L,K,T))+@SUM(ORIGINS(I):V_ILE(I,L,T))-
@SUM(ORIGINS(I):V_LIE(L,I,T))+@SUM(RORO_TERMINALS(J):REP_JL(J,L,T))-@SUM(RORO_TERMINALS(J):REP_LJ(L,J,T))+
@SUM(TRAIN_TERMINALS(K):REP_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(K):REP_LK(L,K,T))+@SUM(ORIGINS(I):REP_ILE(I,L,T))-
@SUM(ORIGINS(I):REP_LIE(L,I,T))+@SUM(RORO_TERMINALS(J):VV_JL(J,L,T))+
@SUM(DESTINATIONS(C)|C#NE#L:V_LL(C,L,T))-@SUM(RORO_TERMINALS(J):VV_LJ(L,J,T))-
@SUM(DESTINATIONS(C)|C#NE#L:V_LL(L,C,T))+@SUM(TRAIN_TERMINALS(K):VV_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(K):VV_LK(L,K,T))+@SUM(ORIGINS(I):EXREP_ILE(I,L,T))-@SUM(ORIGINS(I):EXREP_LIE(L,I,T))));
@FOR(DESTINATIONS(L)|L#LE#10:@FOR(PERIODS(T)|T#EQ#1:V_LE(L,T)=V_LE0(L)+AL_E(L,T)-
SAT_E(L,T)+@SUM(RORO_TERMINALS(J):V_JL(J,L,T))-@SUM(RORO_TERMINALS(J):V_LJ(L,J,T))+
@SUM(TRAIN_TERMINALS(K):V_KL(K,L,T))-@SUM(TRAIN_TERMINALS(K):V_LK(L,K,T))+@SUM(ORIGINS(I):V_ILE(I,L,T))-
@SUM(ORIGINS(I):V_LIE(L,I,T))+@SUM(RORO_TERMINALS(J):REP_JL(J,L,T))-
@SUM(RORO_TERMINALS(J):REP_LJ(L,J,T))+@SUM(TRAIN_TERMINALS(K):REP_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(K):REP_LK(L,K,T))+@SUM(ORIGINS(I):REP_ILE(I,L,T))-@SUM(ORIGINS(I):REP_LIE(L,I,T))+
@SUM(RORO_TERMINALS(J):VV_JL(J,L,T))+@SUM(DESTINATIONS(C)|C#NE#L:V_LL(C,L,T))-
@SUM(RORO_TERMINALS(J):VV_LJ(L,J,T))-@SUM(DESTINATIONS(C)|C#NE#L:V_LL(L,C,T))+
@SUM(TRAIN_TERMINALS(K):VV_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(K):VV_LK(L,K,T))+@SUM(ORIGINS(I):EXREP_ILE(I,L,T))-@SUM(ORIGINS(I):EXREP_LIE(L,I,T))));
@FOR(DESTINATIONS(L)|L#LE#10:@FOR(PERIODS(T)|T#GT#1:V_LE(L,T)=V_LE(L,T-1)+AL_E(L,T)-
SAT_E(L,T)+@SUM(RORO_TERMINALS(J):V_JL(J,L,T))-@SUM(RORO_TERMINALS(J):V_LJ(L,J,T))+
@SUM(TRAIN_TERMINALS(K):V_KL(K,L,T))-@SUM(TRAIN_TERMINALS(K):V_LK(L,K,T))+@SUM(ORIGINS(I):V_ILE(I,L,T))-
@SUM(ORIGINS(I):V_LIE(L,I,T))+@SUM(RORO_TERMINALS(J):REP_JL(J,L,T))-
@SUM(RORO_TERMINALS(J):REP_LJ(L,J,T))+@SUM(TRAIN_TERMINALS(K):REP_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(K):REP_LK(L,K,T))+@SUM(ORIGINS(I):REP_ILE(I,L,T))-@SUM(ORIGINS(I):REP_LIE(L,I,T))+
@SUM(RORO_TERMINALS(J):VV_JL(J,L,T))+@SUM(DESTINATIONS(C)|C#NE#L:V_LL(C,L,T))-
@SUM(RORO_TERMINALS(J):VV_LJ(L,J,T))-@SUM(DESTINATIONS(C)|C#NE#L:V_LL(L,C,T))+
@SUM(TRAIN_TERMINALS(K):VV_KL(K,L,T))-
@SUM(TRAIN_TERMINALS(K):VV_LK(L,K,T))+@SUM(ORIGINS(I):EXREP_ILE(I,L,T))-@SUM(ORIGINS(I):EXREP_LIE(L,I,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#EQ#1:V_LT(L,T)=V_LT0(L)+@SUM(ORIGINS(I):V_ILT(I,L,T))-
@SUM(ORIGINS(I):V_LIT(L,I,T))+
@SUM(ORIGINS(I):REP_ILT(I,L,T))-@SUM(ORIGINS(I):REP_LIT(L,I,T))+@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(C,L,T))-
@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(L,C,T))+@SUM(ORIGINS(I):EXREP_ILT(I,L,T))-
@SUM(ORIGINS(I):EXREP_LIT(L,I,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#GT#1:V_LT(L,T)=V_LT(L,T-1)+@SUM(ORIGINS(I):V_ILT(I,L,T))-
@SUM(ORIGINS(I):V_LIT(L,I,T))+
@SUM(ORIGINS(I):REP_ILT(I,L,T))-@SUM(ORIGINS(I):REP_LIT(L,I,T))+@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(C,L,T))-
@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(L,C,T))+@SUM(ORIGINS(I):EXREP_ILT(I,L,T))-
@SUM(ORIGINS(I):EXREP_LIT(L,I,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#EQ#1:V_IE(I,T)=V_IE0(I)-
@SUM(DESTINATIONS(L):V_ILE(I,L,T))+@SUM(DESTINATIONS(L):V_LIE(L,I,T))-
@SUM(DESTINATIONS(L):REP_ILE(I,L,T))+@SUM(DESTINATIONS(L):REP_LIE(L,I,T))-
@SUM(DESTINATIONS(L):EXREP_ILE(I,L,T))+@SUM(DESTINATIONS(L):EXREP_LIE(L,I,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#GT#1:V_IE(I,T)=V_IE(I,T-1)-
@SUM(DESTINATIONS(L):V_ILE(I,L,T))+@SUM(DESTINATIONS(L):V_LIE(L,I,T))-
@SUM(DESTINATIONS(L):REP_ILE(I,L,T))+@SUM(DESTINATIONS(L):REP_LIE(L,I,T))-
@SUM(DESTINATIONS(L):EXREP_ILE(I,L,T))+@SUM(DESTINATIONS(L):EXREP_LIE(L,I,T))));
@FOR(ORIGINS(I)|I#NE#1:@FOR(PERIODS(T)|T#EQ#1:V_IT(I,T)=V_IT0(I)-
@SUM(DESTINATIONS(L):V_ILT(I,L,T))+@SUM(DESTINATIONS(L):V_LIT(L,I,T))-
@SUM(DESTINATIONS(L):REP_ILT(I,L,T))+@SUM(DESTINATIONS(L):REP_LIT(L,I,T))+@SUM(ORIGINS(D)|D#NE#I:V_II(D,I,T))
-@SUM(ORIGINS(D)|D#NE#I:V_II(I,D,T))-@SUM(DESTINATIONS(L):EXREP_ILT(I,L,T))+
@SUM(DESTINATIONS(L):EXREP_LIT(L,I,T))));
@FOR(ORIGINS(I)|I#NE#1:@FOR(PERIODS(T)|T#GT#1:V_IT(I,T)=V_IT(I,T-1)-
@SUM(DESTINATIONS(L):V_ILT(I,L,T))+@SUM(DESTINATIONS(L):V_LIT(L,I,T))-
@SUM(DESTINATIONS(L):REP_ILT(I,L,T))+@SUM(DESTINATIONS(L):REP_LIT(L,I,T))+@SUM(ORIGINS(D)|D#NE#I:V_II(D,I,T))
-@SUM(ORIGINS(D)|D#NE#I:V_II(I,D,T))-@SUM(DESTINATIONS(L):EXREP_ILT(I,L,T))+
@SUM(DESTINATIONS(L):EXREP_LIT(L,I,T))));
@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T)|T#EQ#1:V_IT(I,T)=V_IT0(I)+AL_T(I,T)-SAT_T(I,T)-
@SUM(DESTINATIONS(L):V_ILT(I,L,T))+@SUM(DESTINATIONS(L):V_LIT(L,I,T))-
@SUM(DESTINATIONS(L):REP_ILT(I,L,T))+@SUM(DESTINATIONS(L):REP_LIT(L,I,T))+@SUM(ORIGINS(D)|D#NE#I:V_II(D,I,T))
-@SUM(ORIGINS(D)|D#NE#I:V_II(I,D,T))-@SUM(DESTINATIONS(L):EXREP_ILT(I,L,T))+
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@SUM(DESTINATIONS(L):EXREP_LIT(L,I,T))));
@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T)|T#GT#1:V_IT(I,T)=V_IT(I,T-1)+AL_T(I,T)-SAT_T(I,T)-
@SUM(DESTINATIONS(L):V_ILT(I,L,T))+@SUM(DESTINATIONS(L):V_LIT(L,I,T))-
@SUM(DESTINATIONS(L):REP_ILT(I,L,T))+@SUM(DESTINATIONS(L):REP_LIT(L,I,T))+@SUM(ORIGINS(D)|D#NE#I:V_II(D,I,T))
-@SUM(ORIGINS(D)|D#NE#I:V_II(I,D,T))-@SUM(DESTINATIONS(L):EXREP_ILT(I,L,T))+
@SUM(DESTINATIONS(L):EXREP_LIT(L,I,T))));
!-------- Periodic trailer inventories at seaports in Turkey & order countries in Europe:-------;
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#EQ#1:ST_L(L,T)=ST_L0(L)+@SUM(ORIGINS(I):X_IMP(I,L,T))+@SUM(MARILINK1(I
,J):Y_IMP(I,J,L,T))+@SUM(ORIGINS(I):@SUM(FULLTRAIN_IMP(J,K):
Z_IMP(I,J,K,L,T)))-@SUM(ORIGINS(I):X_EXP(L,I,T))-@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T))-
@SUM(ORIGINS(I):@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)))+@SUM(ORIGINS(I):ST_IL(I,L,T))-
@SUM(ORIGINS(I):ST_LI(L,I,T))+@SUM(ORIGINS(I):EXST_IL(I,L,T))-
@SUM(ORIGINS(I):EXST_LI(L,I,T))+@SUM(DESTINATIONS(C)|C#NE#L:ST_LL(C,L,T))-
@SUM(DESTINATIONS(C)|C#NE#L:ST_LL(L,C,T))+
@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(C,L,T))-@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(L,C,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#GT#1:ST_L(L,T)=ST_L(L,T-
1)+@SUM(ORIGINS(I):X_IMP(I,L,T))+@SUM(MARILINK1(I,J):Y_IMP(I,J,L,T))+@SUM(ORIGINS(I):@SUM(FULLTRAIN_IMP(J,K):
Z_IMP(I,J,K,L,T)))-@SUM(ORIGINS(I):X_EXP(L,I,T))-@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T))-
@SUM(ORIGINS(I):@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)))+@SUM(ORIGINS(I):ST_IL(I,L,T))-
@SUM(ORIGINS(I):ST_LI(L,I,T))+@SUM(ORIGINS(I):EXST_IL(I,L,T))-
@SUM(ORIGINS(I):EXST_LI(L,I,T))+@SUM(DESTINATIONS(C)|C#NE#L:ST_LL(C,L,T))-
@SUM(DESTINATIONS(C)|C#NE#L:ST_LL(L,C,T))+
@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(C,L,T))-@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(L,C,T))));
@FOR(ORIGINS(I)|I#NE#1:@FOR(PERIODS(T)|T#EQ#1:ST_I(I,T)=ST_I0(I)+@SUM(DESTINATIONS(L):X_EXP(L,I,T))+@SUM(DEST
INATIONS(L):@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T)))
+@SUM(DESTINATIONS(L):@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)))-@SUM(DESTINATIONS(L):X_IMP(I,L,T))-
@SUM(DESTINATIONS(L):@SUM(MARILINK1(I,J):Y_IMP(I,J,L,T)))
-@SUM(DESTINATIONS(L):@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T)))+@SUM(DESTINATIONS(L):ST_LI(L,I,T))-
@SUM(DESTINATIONS(L):ST_IL(I,L,T))+@SUM(DESTINATIONS(L):EXST_LI(L,I,T))-
@SUM(DESTINATIONS(L):EXST_IL(I,L,T))-
@SUM(ORIGINS(D)|D#NE#I:ST_II(I,D,T))+@SUM(ORIGINS(D)|D#NE#I:ST_II(D,I,T))));
@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T)|T#EQ#1:ST_I(I,T)=ST_I0(I)+AL_D(I,T)-
SAT_D(I,T)+@SUM(DESTINATIONS(L):X_EXP(L,I,T))+@SUM(DESTINATIONS(L):@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T)))
+@SUM(DESTINATIONS(L):@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)))-@SUM(DESTINATIONS(L):X_IMP(I,L,T))-
@SUM(DESTINATIONS(L):@SUM(MARILINK1(I,J):Y_IMP(I,J,L,T)))
-@SUM(DESTINATIONS(L):@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T)))+@SUM(DESTINATIONS(L):ST_LI(L,I,T))-
@SUM(DESTINATIONS(L):ST_IL(I,L,T))+@SUM(DESTINATIONS(L):EXST_LI(L,I,T))-
@SUM(DESTINATIONS(L):EXST_IL(I,L,T))-
@SUM(ORIGINS(D)|D#NE#I:ST_II(I,D,T))+@SUM(ORIGINS(D)|D#NE#I:ST_II(D,I,T))));
@FOR(ORIGINS(I)|I#EQ#1:@FOR(PERIODS(T)|T#GT#1:ST_I(I,T)=ST_I(I,T-1)+AL_D(I,T)-
SAT_D(I,T)+@SUM(DESTINATIONS(L):X_EXP(L,I,T))+@SUM(DESTINATIONS(L):@SUM(MARILINK2(J,I):Y_EXP(L,J,I,T)))
+@SUM(DESTINATIONS(L):@SUM(FULLTRAIN_EXP(K,J):Z_EXP(L,K,J,I,T)))-@SUM(DESTINATIONS(L):X_IMP(I,L,T))-
@SUM(DESTINATIONS(L):@SUM(MARILINK1(I,J):Y_IMP(I,J,L,T)))
-@SUM(DESTINATIONS(L):@SUM(FULLTRAIN_IMP(J,K):Z_IMP(I,J,K,L,T)))+@SUM(DESTINATIONS(L):ST_LI(L,I,T))-
@SUM(DESTINATIONS(L):ST_IL(I,L,T))+@SUM(DESTINATIONS(L):EXST_LI(L,I,T))-
@SUM(DESTINATIONS(L):EXST_IL(I,L,T))-
@SUM(ORIGINS(D)|D#NE#I:ST_II(I,D,T))+@SUM(ORIGINS(D)|D#NE#I:ST_II(D,I,T))));
!*********MODEL COMPONENT - IV: EXTERNAL EMPTY TRUCK & TRAILER REPOSITIONING ISSUES***********;
!---------------The external European & Turkish plated empty truck repositions:--------------;
@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T)|T#EQ#1:V_J0(J)>=@SUM(DESTINATIONS(L):VEC_JL(J,L,T))));
!;@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T)|T#GT#1:@SUM(DESTINATIONS(L):VV_LJ(L,J,T-
1))+@SUM(RORO_TERMINALS(N)|N#NE#J:V_JJ(N,J,T-1))+@SUM(TRAIN_TERMINALS(K):V_KJ(K,J,T-1))>=
@SUM(DESTINATIONS(L):VEC_JL(J,L,T))-@SUM(DESTINATIONS(L):V_J(J,T-1))));
@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T)|T#EQ#1:V_K0(K)>=@SUM(DESTINATIONS(L):VEC_KL(K,L,T))));
@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T)|T#GT#1:@SUM(DESTINATIONS(L):VV_LK(L,K,T-
1))+@SUM(TRAIN_TERMINALS(B)|B#NE#K:V_KK(B,K,T-1))+@SUM(RORO_TERMINALS(J):V_JK(J,K,T-1))>=
@SUM(DESTINATIONS(L):VEC_KL(K,L,T))-V_K(K,T-1)));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#EQ#1:V_LE0(L)>=@SUM(TRAIN_TERMINALS(K):VEC_LK(L,K,T))+@SUM(RORO_TERMIN
ALS(J):VEC_LJ(L,J,T))+@SUM(ORIGINS(I):EP_LI(L,I,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#GT#1:@SUM(DESTINATIONS(C)|C#NE#L:V_LL(C,L,T-
1))+@SUM(RORO_TERMINALS(J):VV_JL(J,L,T-1))+
@SUM(TRAIN_TERMINALS(K):VV_KL(K,L,T-1))+@SUM(ORIGINS(I):EXREP_ILE(I,L,T-
1))>=@SUM(TRAIN_TERMINALS(K):VEC_LK(L,K,T))+
@SUM(RORO_TERMINALS(J):VEC_LJ(L,J,T))+@SUM(ORIGINS(I):EP_LI(L,I,T))-V_LE(L,T-1)));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#EQ#1:V_LT0(L)>=@SUM(ORIGINS(I):TP_LI(L,I,T))));
!;@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#GT#1:@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(C,L,T-
1))+@SUM(ORIGINS(I):EXREP_ILT(I,L,T-1))>=@SUM(ORIGINS(I):TP_LI(L,I,T))-V_LT(L,T-1)));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#EQ#1:V_IE0(I)>=@SUM(DESTINATIONS(L):EP_IL(I,L,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#GT#1:@SUM(DESTINATIONS(L):EXREP_LIE(L,I,T-
1))>=@SUM(DESTINATIONS(L):EP_IL(I,L,T))-V_IE(I,T-1)));
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@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#EQ#1:V_IT0(I)>=@SUM(DESTINATIONS(L):TP_IL(I,L,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#GT#1:@SUM(ORIGINS(D)|D#NE#I:V_II(D,I,T-
1))+@SUM(DESTINATIONS(L):EXREP_LIT(L,I,T-1))>=@SUM(DESTINATIONS(L):TP_IL(I,L,T))-V_IT(I,T-1)));
!-----------------------The external empty trailer repositions:--------------------------;
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#EQ#1:ST_L0(L)>=@SUM(ORIGINS(I):TRAI_LI(L,I,T))));
!;@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#GT#1:@SUM(DESTINATIONS(C)|C#NE#L:ST_LL(C,L,T-
1))+@SUM(ORIGINS(I):EXST_IL(I,L,T-1))+@SUM(DESTINATIONS(C)|C#NE#L:TT_LL(C,L,T-1))>=
@SUM(ORIGINS(I):TRAI_LI(L,I,T))-ST_L(L,T-1)));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#EQ#1:ST_I0(I)>=@SUM(DESTINATIONS(L):TRAI_IL(I,L,T))));
!;@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#GT#1:@SUM(ORIGINS(D)|D#NE#I:ST_II(D,I,T-
1))+@SUM(DESTINATIONS(L):EXST_LI(L,I,T-1))>=@SUM(DESTINATIONS(L):TRAI_IL(I,L,T))-ST_I(I,T-1)));
!--The logical constraints for relationship between external empty truck & trailer repositions-;
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(DESTINATIONS(C)|C#NE#L:V_LL(C,L,T)>=ST_LL(C,L,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T):@FOR(ORIGINS(D)|D#NE#I:V_II(D,I,T)>=ST_II(D,I,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):EXREP_ILE(I,L,T)+EXREP_ILT(I,L,T)>=EXST_IL(I,L,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):EXREP_LIE(L,I,T)+EXREP_LIT(L,I,T)>=EXST_LI(L,I,T))));
!---------Idle truck numbers--------;
@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T)|T#EQ#1:IDLE_J(J,T)=V_J0(J)-@SUM(DESTINATIONS(L):VEC_JL(J,L,T))));
@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T)|T#GT#1:IDLE_J(J,T)=V_J(J,T-1)-@SUM(DESTINATIONS(L):VEC_JL(J,L,T))));
@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T)|T#EQ#1:IDLE_K(K,T)=V_K0(K)-@SUM(DESTINATIONS(L):VEC_KL(K,L,T))));
@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T)|T#GT#1:IDLE_K(K,T)=V_K(K,T-1)-@SUM(DESTINATIONS(L):VEC_KL(K,L,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#EQ#1:IDLE_LE(L,T)=V_LE0(L)-@SUM(TRAIN_TERMINALS(K):VEC_LK(L,K,T))-
@SUM(RORO_TERMINALS(J):VEC_LJ(L,J,T))-@SUM(ORIGINS(I):EP_LI(L,I,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#GT#1:IDLE_LE(L,T)=V_LE(L,T-1)-@SUM(TRAIN_TERMINALS(K):VEC_LK(L,K,T))-
@SUM(RORO_TERMINALS(J):VEC_LJ(L,J,T))-@SUM(ORIGINS(I):EP_LI(L,I,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#EQ#1:IDLE_LT(L,T)=V_LT0(L)-@SUM(ORIGINS(I):TP_LI(L,I,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#GT#1:IDLE_LT(L,T)=V_LT(L,T-1)-@SUM(ORIGINS(I):TP_LI(L,I,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#EQ#1:IDLE_IT(I,T)=V_IT0(I)-@SUM(DESTINATIONS(L):TP_IL(I,L,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#GT#1:IDLE_IT(I,T)=V_IT(I,T-1)-@SUM(DESTINATIONS(L):TP_IL(I,L,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#EQ#1:IDLE_IE(I,T)=V_IE0(I)-@SUM(DESTINATIONS(L):EP_IL(I,L,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#GT#1:IDLE_IE(I,T)=V_IE(I,T-1)-@SUM(DESTINATIONS(L):EP_IL(I,L,T))));
!--------Idle trailer numbers----------;
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#EQ#1:IDLE_DORL(L,T)=ST_L0(L)-@SUM(ORIGINS(I):TRAI_LI(L,I,T))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T)|T#GT#1:IDLE_DORL(L,T)=ST_L(L,T-1)-@SUM(ORIGINS(I):TRAI_LI(L,I,T))));
@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#EQ#1:IDLE_DORI(I,T)=ST_I0(I)-@SUM(DESTINATIONS(L):TRAI_IL(I,L,T))));
!;@FOR(ORIGINS(I):@FOR(PERIODS(T)|T#GT#1:IDLE_DORI(I,T)=ST_I(I,T-1)-@SUM(DESTINATIONS(L):TRAI_IL(I,L,T))));
!----------------Loaded truck positions in terms of kilometers---------------;
@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):VD_JL(J,L,T)=V_JL(J,L,T)*D_JL(J,L))));
@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):VD_KL(K,L,T)=V_KL(K,L,T)*D_KL(K,L))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):VD_LIE(L,I,T)=V_LIE(L,I,T)*D_LI(L,I))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):VD_LIT(L,I,T)=V_LIT(L,I,T)*D_LI(L,I))));
@FOR(RORO_TERMINALS(J):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):VD_LJ(L,J,T)=V_LJ(L,J,T)*D_LJ(L,J))));
@FOR(TRAIN_TERMINALS(K):@FOR(PERIODS(T):@FOR(DESTINATIONS(L):VD_LK(L,K,T)=V_LK(L,K,T)*D_LK(L,K))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):VD_ILE(I,L,T)=V_ILE(I,L,T)*D_IL(I,L))));
@FOR(DESTINATIONS(L):@FOR(PERIODS(T):@FOR(ORIGINS(I):VD_ILT(I,L,T)=V_ILT(I,L,T)*D_IL(I,L))));

!--------------Idle Truck&Trailer Positions In Terms Of Kilometers -------------------;
! Internal truck&trailer positions in terms of kilometers;
@FOR(RE_JL(J,L,T):REPP_JL(J,L,T)=REP_JL(J,L,T)*D_JL(J,L));
@FOR(RE_LJ(L,J,T):REPP_LJ(L,J,T)=REP_LJ(L,J,T)*D_LJ(L,J));
@FOR(RE_KL(K,L,T):REPP_KL(K,L,T)=REP_KL(K,L,T)*D_KL(K,L));
@FOR(RE_LK(L,K,T):REPP_LK(L,K,T)=REP_LK(L,K,T)*D_LK(L,K));
@FOR(RE_LI(L,I,T):REPP_LIE(L,I,T)=REP_LIE(L,I,T)*D_LI(L,I));
@FOR(RE_IL(I,L,T):REPP_ILE(I,L,T)=REP_ILE(I,L,T)*D_IL(I,L));
@FOR(RE_LI(L,I,T):REPP_LIT(L,I,T)=REP_LIT(L,I,T)*D_LI(L,I));
@FOR(RE_IL(I,L,T):REPP_ILT(I,L,T)=REP_ILT(I,L,T)*D_IL(I,L));
@FOR(RE_IL(I,L,T):STT_IL(I,L,T)=ST_IL(I,L,T)*D_IL(I,L));
@FOR(RE_LI(L,I,T):STT_LI(L,I,T)=ST_LI(L,I,T)*D_LI(L,I));
!External truck&trailer positions in terms of kilometers;
@FOR(RE_JK(J,K,T):VX_JK(J,K,T)=V_JK(J,K,T)*D_JK(J,K));
@FOR(RE_KJ(K,J,T):VX_KJ(K,J,T)=V_KJ(K,J,T)*D_KJ(K,J));
@FOR(REPOSITION_J(J,N,T):VX_JJ(J,N,T)=V_JJ(J,N,T)*D_JJ(J,N));
@FOR(RE_JL(J,L,T):VVX_JL(J,L,T)=VV_JL(J,L,T)*D_JL(J,L));
@FOR(RE_LJ(L,J,T):VVX_LJ(L,J,T)=VV_LJ(L,J,T)*D_LJ(L,J));
@FOR(REPOSITION_L(L,C,T):VX_LL(L,C,T)=V_LL(L,C,T)*D_LL(L,C));
@FOR(REPOSITION_I(I,D,T):VX_II(I,D,T)=V_II(I,D,T)*D_II(I,D));
@FOR(RE_KL(K,L,T):VVX_KL(K,L,T)=VV_KL(K,L,T)*D_KL(K,L));
@FOR(RE_LK(L,K,T):VVX_LK(L,K,T)=VV_LK(L,K,T)*D_LK(L,K));
@FOR(REPOSITION_K(K,B,T):VX_KK(K,B,T)=V_KK(K,B,T)*D_KK(K,B));
@FOR(RE_IL(I,L,T):EXREPX_ILE(I,L,T)=EXREP_ILE(I,L,T)*D_IL(I,L));
@FOR(RE_LI(L,I,T):EXREPX_LIE(L,I,T)=EXREP_LIE(L,I,T)*D_LI(L,I));
@FOR(RE_IL(I,L,T):EXREPX_ILT(I,L,T)=EXREP_ILT(I,L,T)*D_IL(I,L));
@FOR(RE_LI(L,I,T):EXREPX_LIT(L,I,T)=EXREP_LIT(L,I,T)*D_LI(L,I));
@FOR(RE_IL(I,L,T):EXSTX_IL(I,L,T)=EXST_IL(I,L,T)*D_IL(I,L));
@FOR(RE_LI(L,I,T):EXSTX_LI(L,I,T)=EXST_LI(L,I,T)*D_LI(L,I));
@FOR(REPOSITION_I(I,D,T):STX_II(I,D,T)=ST_II(I,D,T)*D_II(I,D));
@FOR(REPOSITION_L(L,C,T):STX_LL(L,C,T)=ST_LL(L,C,T)*D_LL(L,C));
@FOR(REPOSITION_L(L,C,T):TTX_LL(L,C,T)=TT_LL(L,C,T)*D_LL(L,C));
```

```
! Non-negativity and integrality restrictions of decision variables;
@FOR(SHIPPMENT_IMP:@GIN(X_IMP));
@FOR(SHIPPMENT_EXP:@GIN(X_EXP));
@FOR(SEMI_INTERMODAL_IMP:@GIN(Y_IMP));
@FOR(SEMI_INTERMODAL_EXP:@GIN(Y_EXP));
@FOR(INTERMODAL_IMP:@GIN(Z_IMP));
@FOR(INTERMODAL_EXP:@GIN(Z_EXP));
@FOR(SHIPPMENT_IJ_IMP2:@GIN(PUB_IJ_IMP));
@FOR(SHIPPMENT_JI_EXP2:@GIN(PUB_JI_EXP));
@FOR(SHIPPMENT_SJK_IMP:@GIN(SJK_IMP));
@FOR(SHIPPMENT_SKJ_EXP:@GIN(SKJ_EXP));
@FOR(SHIPPMENT_JK_IMP:@GIN(PUB_JK_IMP));
@FOR(SHIPPMENT_KJ_EXP:@GIN(PUB_KJ_EXP));
@FOR(SHIPPMENT_KK_IMP:@GIN(PUB_SK_IMP));
@FOR(SHIPPMENT_KK_EXP:@GIN(PUB_KS_EXP));
@FOR(SHIPPMENT_IMP:@GIN(SP_IMP));
@FOR(SHIPPMENT_EXP:@GIN(SP_EXP));
@FOR(SHIPPMENT_IJ_IMP1:@GIN(OWN_IMP));
@FOR(SHIPPMENT_JI_EXP1:@GIN(OWN_EXP));
@FOR(RE_JL:@GIN(V_JL));
@FOR(RE_LJ:@GIN(V_LJ));
@FOR(RE_KL:@GIN(V_KL));
@FOR(RE_LK:@GIN(V_LK));
@FOR(RE_IL:@GIN(V_ILE));
@FOR(RE_IL:@GIN(V_ILT));
@FOR(RE_LI:@GIN(V_LIE));
@FOR(RE_LI:@GIN(V_LIT));
!(108) Bound-Constraints;
@FOR(SHIPPMENT_IJ_IMP11:@BND(0,UTI_IMP,1));
@FOR(SHIPPMENT_JI_EXP11:@BND(0,UTI_EXP,1));
```