

“ENERGETIC” KPI IN LOGISTICS: COMPLEX SYSTEM THEORY AND MULTI-LEVEL MODELING

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The proposed model defines a methodology to estimate Key Performance Indicators (KPIs) in Logistics. The KPIs are structured in three main hierarchical levels. The final KPI (KPI level 3) represents the total KPI (“Energetic” KPI) considering all the parameters. The KPIs are referred two 2 hypothesized vehicle fleets travelling in two different regions.

Each KPI can be expressed as:

$$KPI = ax_1 + bx_2 + \dots,$$

where a, b, ... are the weight coefficients and x1, x2, ... are the parameters defined in the table. Each KPI must be properly normalized in order to use the same scale.

Level	KPI	DESCRIPTION
1	$KPI\ D_i = f(D_s, D_e, \dots)$	KPI driver (Ds=driver style depending on parameters such as average velocity and others; De=driver efficiency) [1].
1	$V_i (KPI\ vehicle\ V_i) = f(\gamma, Cw, Rl, Sfc, vkw, Es, fc, ml, \dots)$	[2] γ : load factor; CW cargo weight; Rl: router length; Sfc: specific fuel consumption as L/100km; vkw: vehicle kerb weight; [1] Es: engine stress; fc: fuel consumption; ml: maintenance level (predictive maintenance information).
1	$KPfi = f(KPI\ D_i, V_i)$	KPI embedding information of KPI Di and Vi.
1	$KPIE1\ (or\ KPI\ E2) = f(lp, tr, tor, \dots)$	Indicator depending on the specific fleet (lp: load prediction for the specific region; tr: traffic; tor: type of road).
1	$KPIE3 = f(fp, et, \dots)$	Exogeneous indicators such as fp: fuel price; et: economic trend.
2	$KPIE\ level2 = f(KPfi, KPIE1, KPI\ E2, KPIE3, M1, HR)$	KPI embedding information of KPfi, KPIE1, KPI E2, KPIE3, M1 (process management indicators including logistics planning efficiency and vehicle management), HR (human resource indicators about the correct choice of drivers). KPI level 2 can be a supernode reducing network complexity [3].
3	$KPI\ level3(Final\ "Energy"\ Indicator) = f(KPIE\ level2, \dots)$	KPI embedding information of all KPIE level2. The term “Energy” indicates the final indicator.

Table: List of parameters defining KPIs.

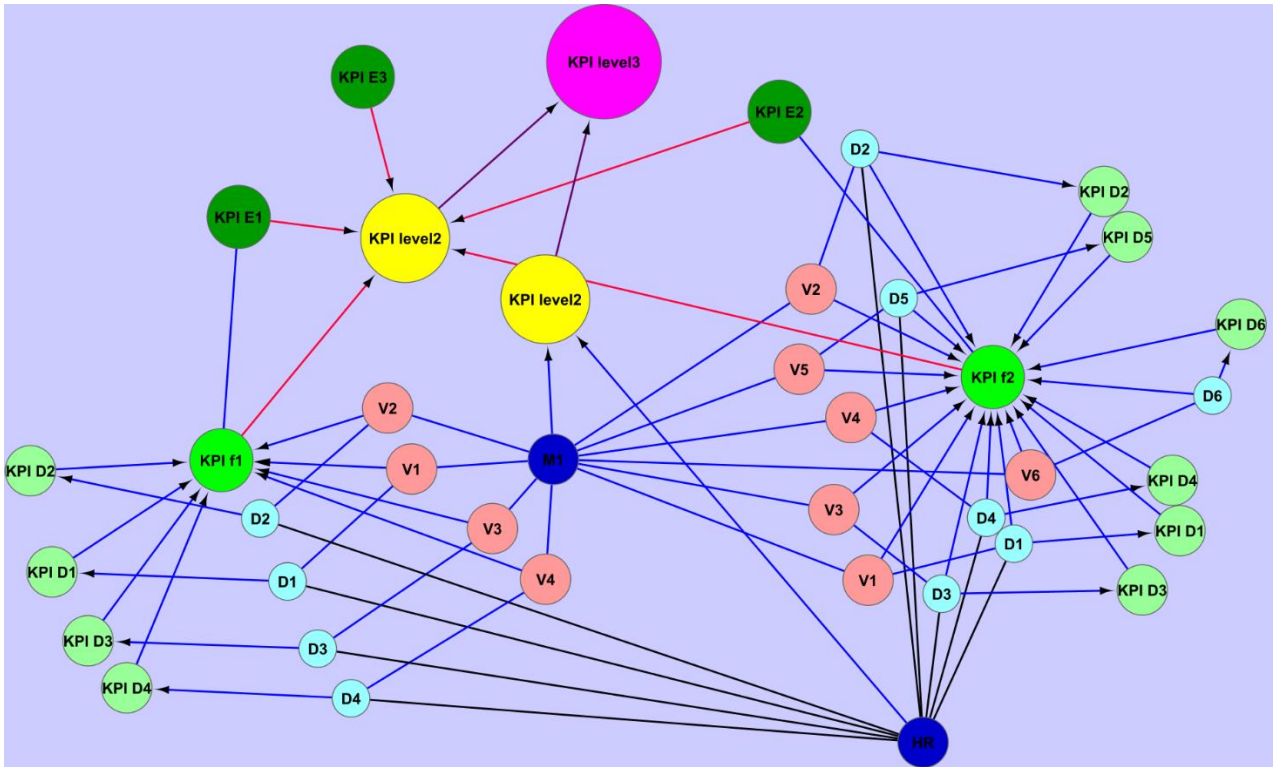


Figure: Complex system: multi-level approach defining “Energetic” KPI in Logistics.

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