

Food Convergent Innovation in Dairy Businesses and Sector: Multi-Indicator Supply Chain Management Framework and Traceability Requirements

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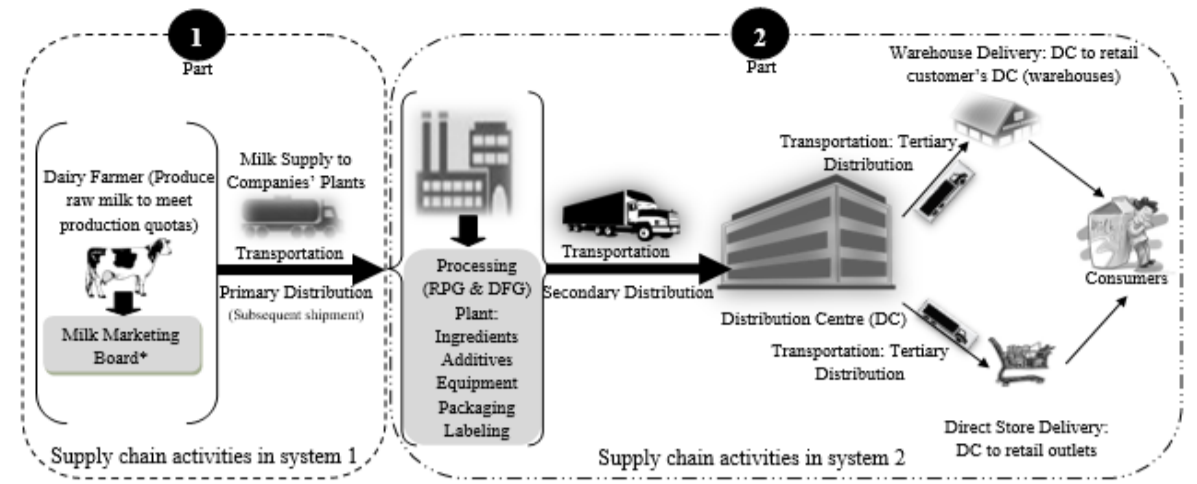
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Introduction

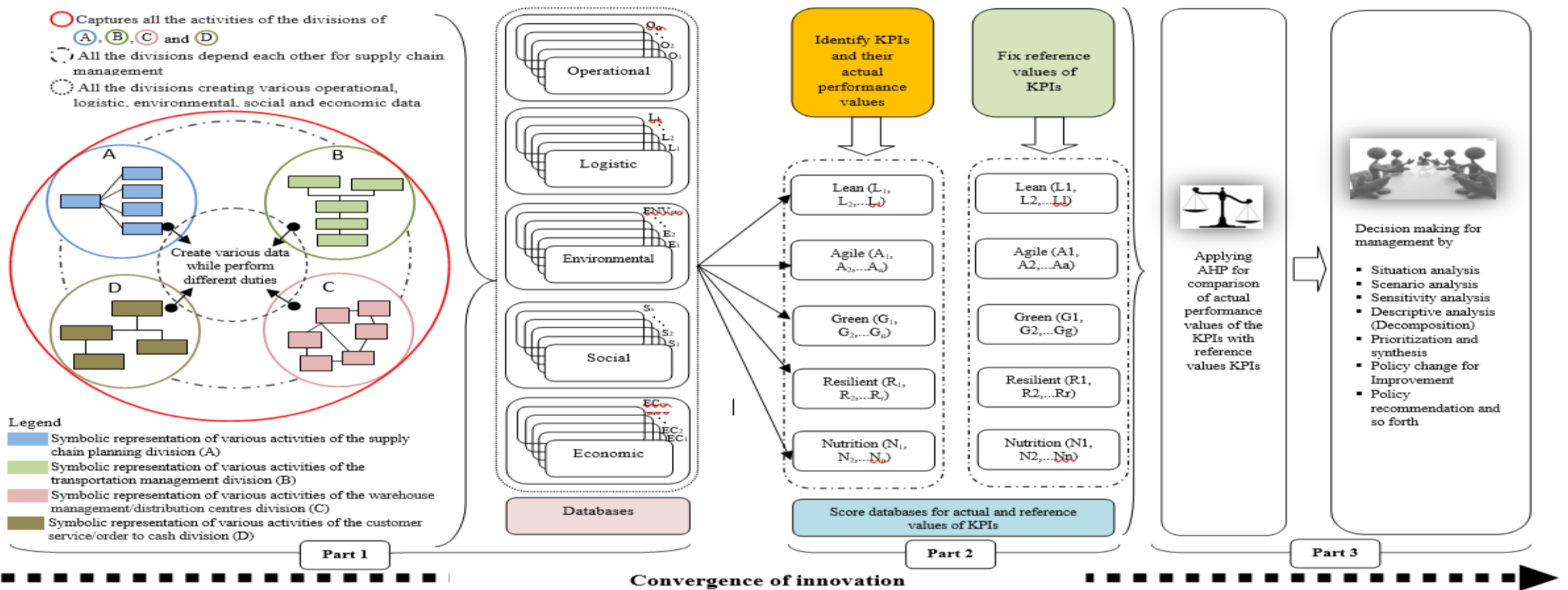
Supply chain of dairy businesses and sector is very complex and dynamic as portrayed in the righthand figure. The traceability of the dairy supply chain requires a multi-indicator based monitoring systems. Hence, the main objective of the paper is to develop a holistic framework for dairy business decision support tool that assemble Key Performance Indicators (KPIs) building upon existing research and practice of supply chain paradigms assembled under the food convergent innovation (FCI) umbrella, i.e., lean, agile, green, resilient and nutritious. FCI is a metaframework that allows integrating multiple indicators to open new frontiers for commercial innovation, supply chains and market systems. FCI places convergence of economic, health, social and environmental outcome indicators as target of both business decisions and those of actors throughout society that can contribute to supply and demand for such a convergent outcome.



Note: **1** This part of the supply chain is the sole responsibility of the *Milk Marketing Board through a "quota system". Dairy Farmers are the members of the Milk Board. The Milk Marketing Board negotiates with processors on behalf of farmers to establish prices and is also responsible for inspecting farms to ensure food safety and animal welfare.
2 Here raw milk is processed into dairy products ready for consumers. RPG = Refrigerated Product Group (fluid milk; cultured products: yogurt, sour cream, cottage cheese and juices); DFG = Dairy Food Group (cheese, table spreads and ingredients)

Methodology

A systematic literature review was combined with participant observation with supply chain management and personnel in a large dairy company. Experts reviewed essential traceability indicators, their parameters, threshold values and weighting of the indicators. A Multi Criteria Decision Analysis (MCDA) framework was then used for developing the framework for ensuring traceability of the supply chain.



Results

Paradigms	KPIs*	Indicator to develop KPIs
Lean (L)	Waste Management Performance (WMP)	Waste from inappropriate processing Rate of product defects HCCAP checklist
	Inventory Performance (IP)	Frequent product inspection
Agile (A)	Supply-Chain Network Performance (SCNP)	Food safety inspection in delivery (reliability) Safety performance in delivery (HCCAP)
	Customer Care Services Performance (CCSP)	Attention to customer complaints on food safety and recall Satisfaction of customer care service on food safety and recall
	Financial Performance (FP) Supply Chain Flexibility (SCF)	Food traceability cost Supply chain adaptability in ensuring traceability
Green (G)	Human Equity (HE)	Biosafety Working conditions transparency Health and safety management
	Environment (ENV)	Checking of environmental and biosafety contamination (HCCAP) Packaging quality Damage in transit
Resilient (R)	Delivery Performance (DP)	Transportation delays and quality of product Transportation disruption and quality of product Defective product
	Operations Performance (OP)	Equipment obsolescence Production interruption Production or technological change
	Information Systems Efficiency (ISE)	Information quality and security Information technology control failures Transparency in database management*
Nutrition (N) ^o	Essential Nutrient (EN) ^o	Quality of product and health benefits Nutritional quality of ingredients ^o Organic/Vegetable ingredients (such as protein) in number of products ^o
	Nutrition Features (NF) ^o	Standardized labelling of nutrition

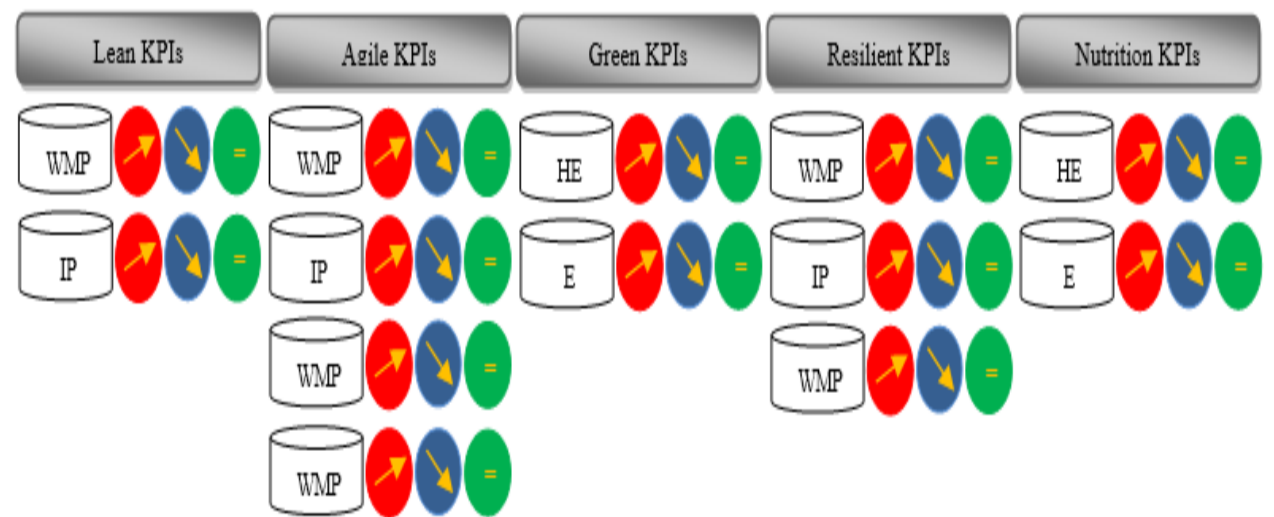


Figure : Dashboard of actual performance of KPIs with respect to reference values of KPIs. Note: *DKPIs = Dashboard of KPIs. Actual value of KPI above reference value ■ actual value of KPI below reference value ■ actual value of KPI equal to reference value ■ Point to be noted that companies will like to have a higher or equal target tendency for the KPIs. Increase target tendency express the better performance of the supply chain performance.

Discussion and Conclusions

The study identifies a set of essential indicators and their measurement techniques. The systemic data collection and integration of these indicators into an integrative decision-making tool for convergent innovation requires significant advances in traceability science and technology as well as in the integration of these into existing operational and management information systems. The framework suggests step by step procedures to develop a dashboard for tracking the performance of the indicators.

The proposed analytical framework is to be empirically validated and pilot tested for its ability to systematically evaluate and improve the dairy supply chain from end-to-end. This paper address challenges and possibilities in mainstreaming this approach to dairy supply chain in different institutional contexts and its generalizability to other agri-food sectors that altogether contributes to food security, safety, human and environmental health around the world.