METRICS

- MEASURE -

Prof. Riccardo Melloni
riccardo.melloni@unimore.it

Università di Modena and Reggio Emilia
Dipartimento di Ingegneria “Enzo Ferrari”
via Vignolese 905, 41100, Modena - Italia

Gruppo di Ricerca: “Impianti Industriali”

059-2056113

Ing. Giovanni Davoli
Ing. Andrea Govoni
Ing. Sergio A. Gallo.

TERMS

measure

- quantitative expression of an attribute of a product or process;

measurement

- the act of determining a measure;

metric

- quantitative measure of the degree to which a system, component or process possesses an attribute;

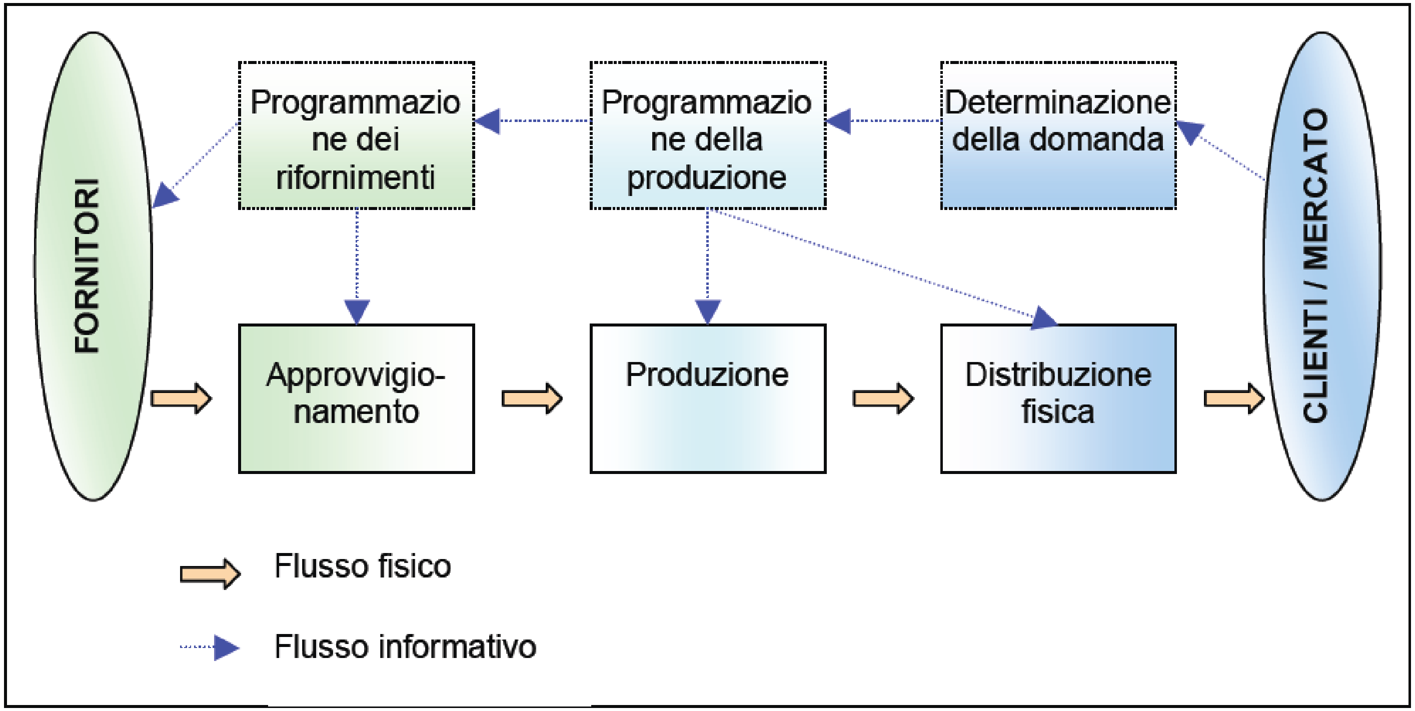
indicator

- a metric that provides insight into the process or project;
- enables manager to adjust (improve) the process or project;

process indicators

- allow assessment of process in terms of what works and what doesn’t;

Supply Chain

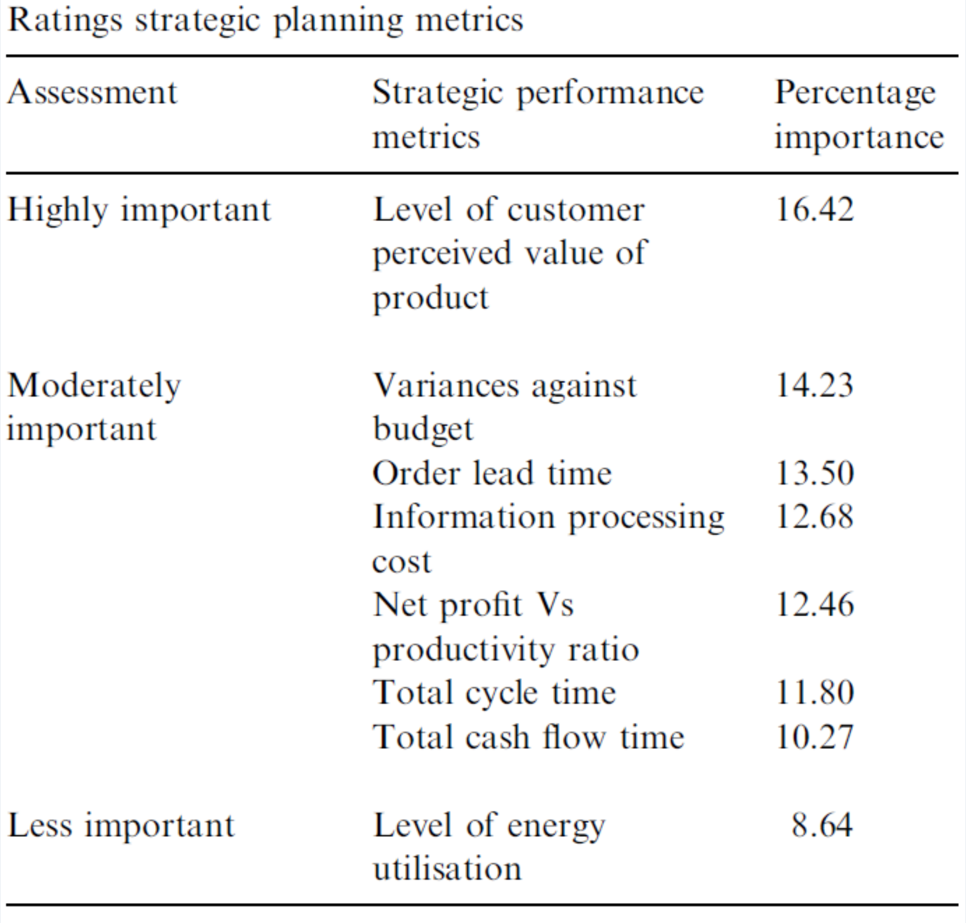

FORNITORI
Programmazione dei rifornimenti
Programmazione della produzione
Determinazione della domanda
CLIENTI / MERCATO
Approvvigionamento
Produzione
Distribuzione fisica
Flusso fisico
Flusso informativo

Il flusso delle informazioni è costituito da quattro fasi:

1. previsione di vendita;
2. gestione degli ordini consuntivati;
3. preparazione del programma generale di produzione;
4. pianificazione dei fabbisogni.

Supply Chain Performance Measurement – strategic

A. Gunasekaran et al. / Int. J. Production Economics 87 (2004) 333–347

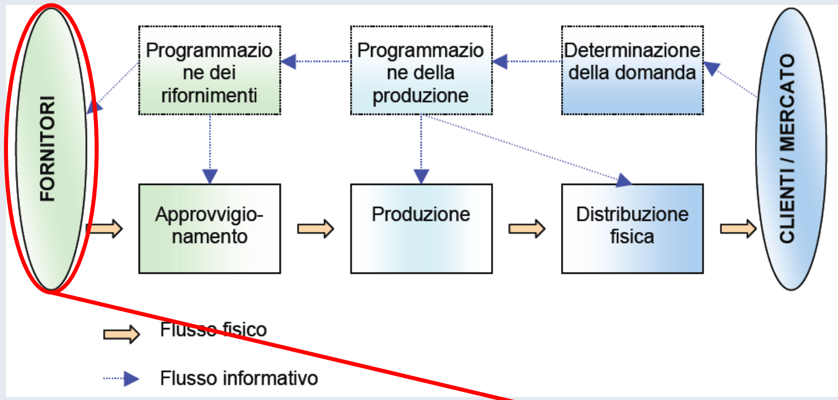


Ratings strategic planning metrics

Assessment	Strategic performance metrics	Percentage importance
Highly important	Level of customer perceived value of product	16.42
Moderately important	Variances against budget	14.23
	Order lead time	13.50
	Information processing cost	12.68
	Net profit Vs productivity ratio	12.46
	Total cycle time	11.80
	Total cash flow time	10.27
Less important	Level of energy utilisation	8.64

Supply Chain Performance Measurement – tactical

A. Gunasekaran et al. / Int. J. Production Economics 87 (2004) 333–347



FORNITORI

Programmazione dei rifornimenti

Programmazione della produzione

Determinazione della domanda

CLIENTI / MERCATO

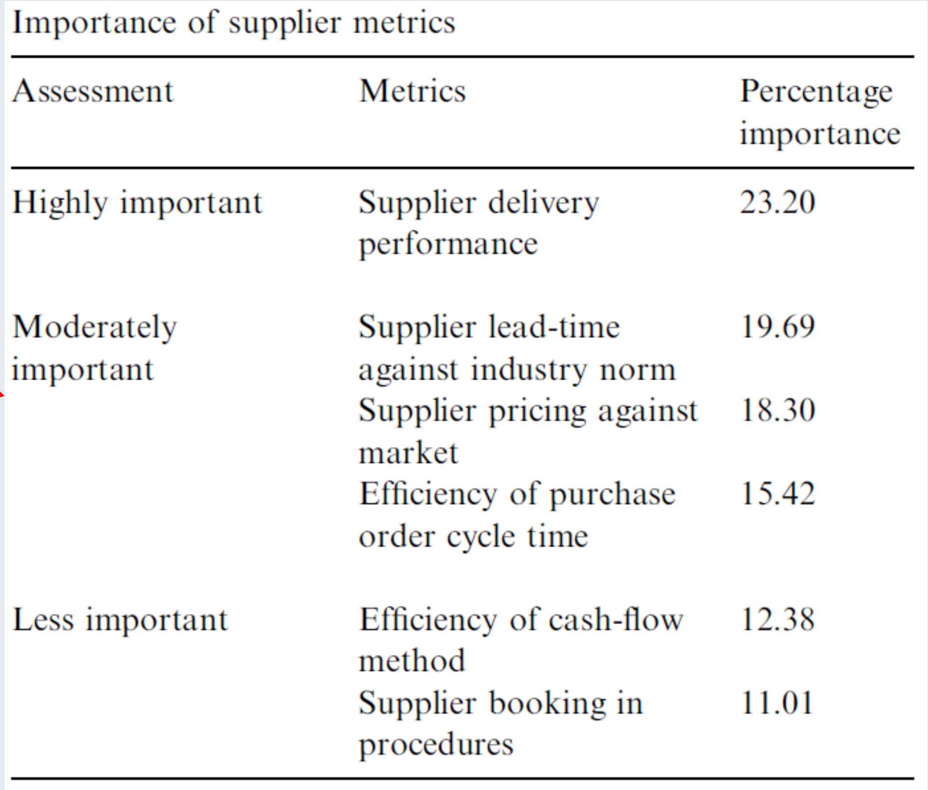
Approvvigionamento

Produzione

Distribuzione fisica

Flusso fisico

Flusso informativo

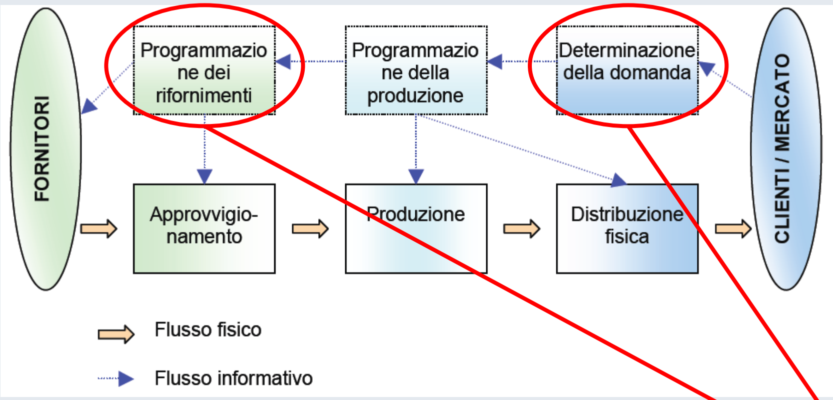


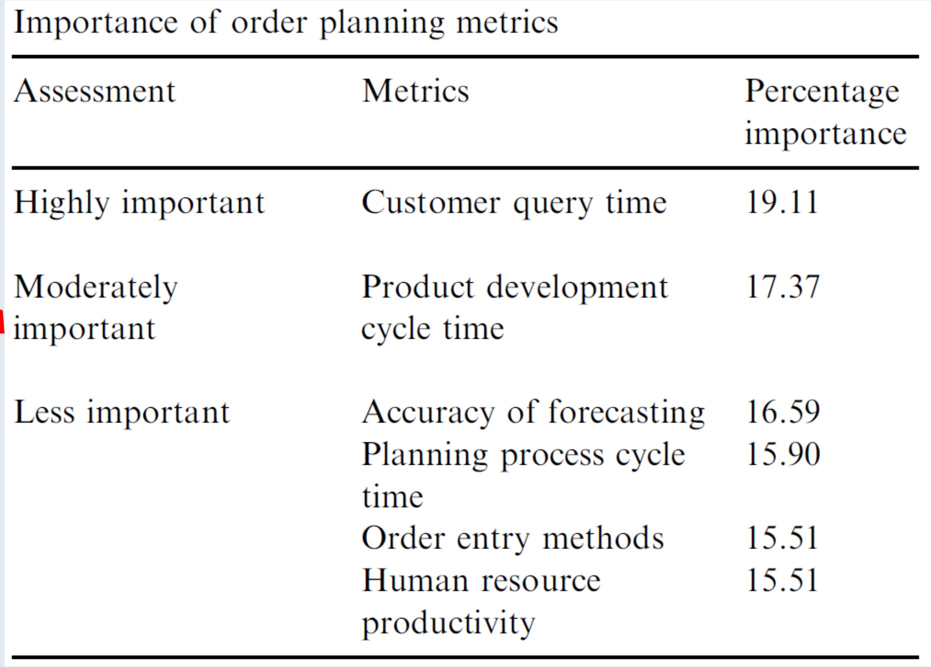
Importance of supplier metrics

Assessment	Metrics	Percentage importance
Highly important	Supplier delivery performance	23.20
Moderately important	Supplier lead-time against industry norm	19.69
	Supplier pricing against market	18.30
	Efficiency of purchase order cycle time	15.42
Less important	Efficiency of cash-flow method	12.38
	Supplier booking in procedures	11.01

Supply Chain Performance Measurement – tactical

A. Gunasekaran et al. / Int. J. Production Economics 87 (2004) 333–347


FORNITORI
Programmazione dei rifornimenti
Programmazione della produzione
Determinazione della domanda
CLIENTI / MERCATO
Approvvigionamento
Produzione
Distribuzione fisica
Flusso fisico
Flusso informativo

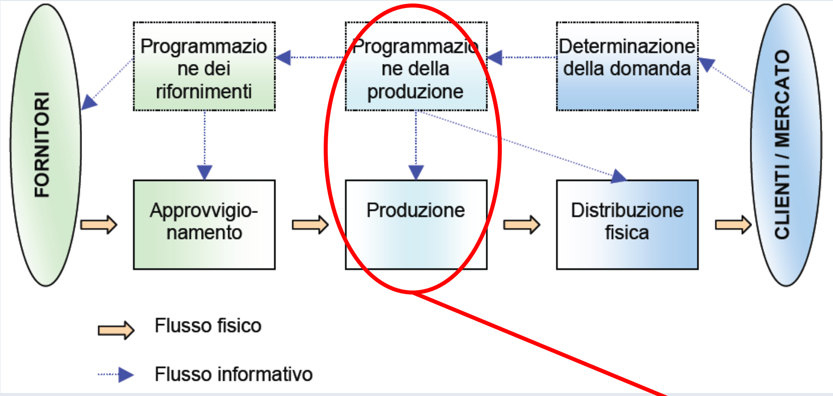


Importance of order planning metrics

Assessment	Metrics	Percentage importance
Highly important	Customer query time	19.11
Moderately important	Product development cycle time	17.37
Less important	Accuracy of forecasting	16.59
	Planning process cycle time	15.90
	Order entry methods	15.51
	Human resource productivity	15.51

Supply Chain Performance Measurement – tactical

A. Gunasekaran et al. / Int. J. Production Economics 87 (2004) 333–347



FORNITORI

Programmazione dei rifornimenti

Programmazione della produzione

Determinazione della domanda

CLIENTI / MERCATO

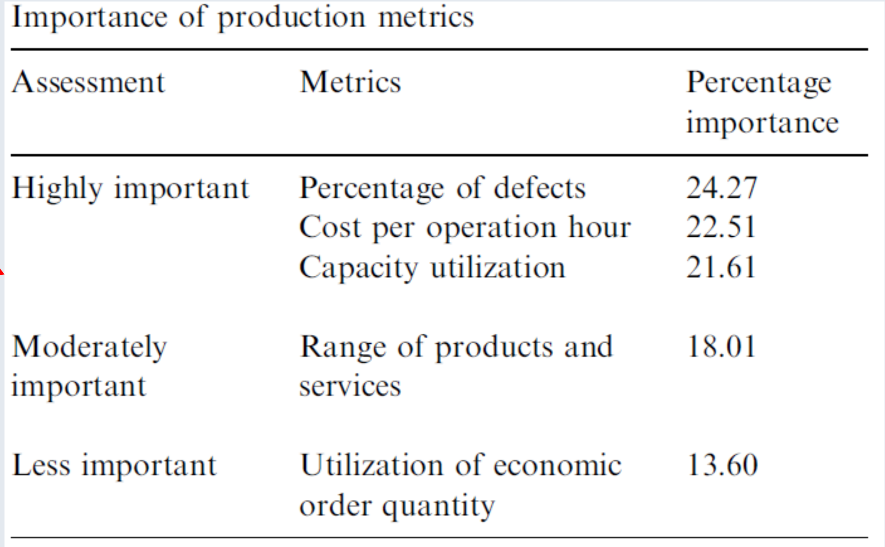
Approvvigio-namento

Produzione

Distribuzione fisica

Flusso fisico

Flusso informativo

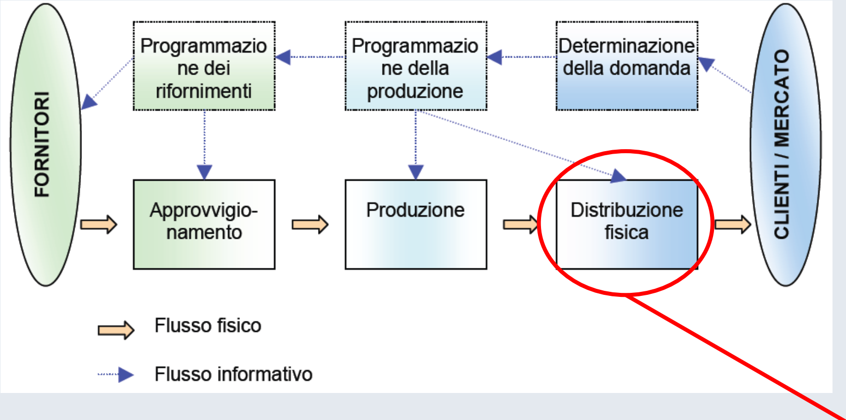


Importance of production metrics

Assessment	Metrics	Percentage importance
Highly important	Percentage of defects	24.27
	Cost per operation hour	22.51
	Capacity utilization	21.61
Moderately important	Range of products and services	18.01
Less important	Utilization of economic order quantity	13.60

Supply Chain Performance Measurement – tactical

A. Gunasekaran et al. / Int. J. Production Economics 87 (2004) 333–347



FORNITORI

Programmazione dei rifornimenti

Programmazione della produzione

Determinazione della domanda

CLIENTI / MERCATO

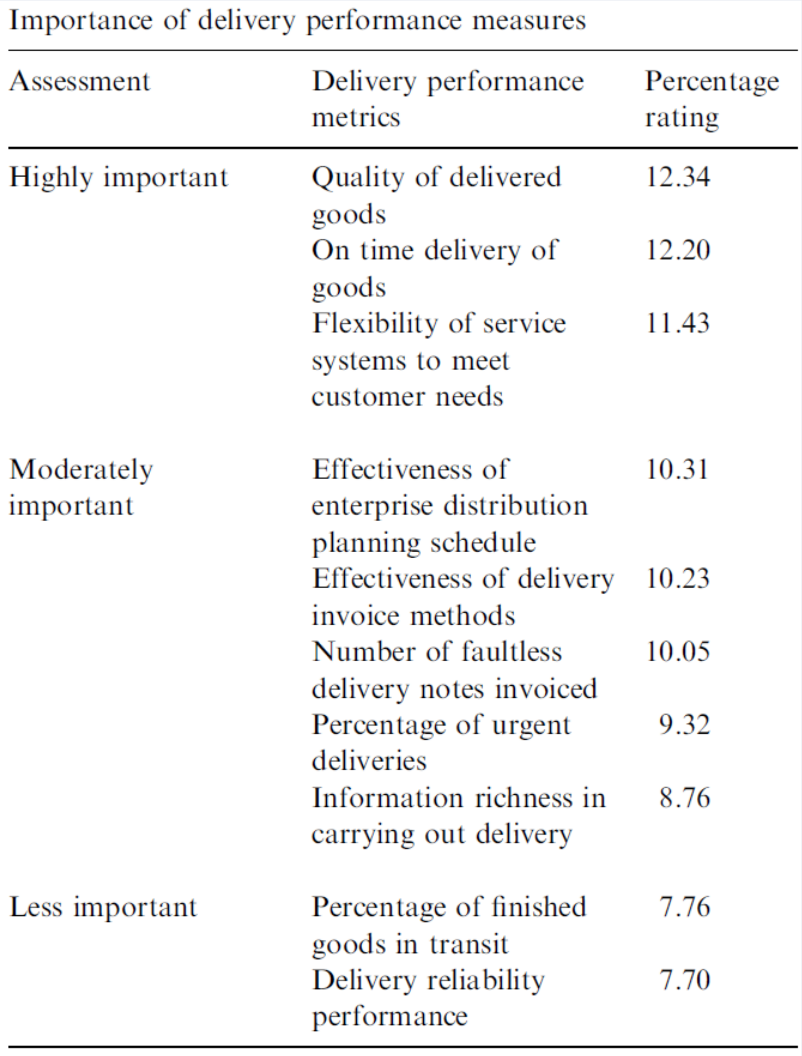
Approvvigionamento

Produzione

Distribuzione fisica

Flusso fisico

Flusso informativo

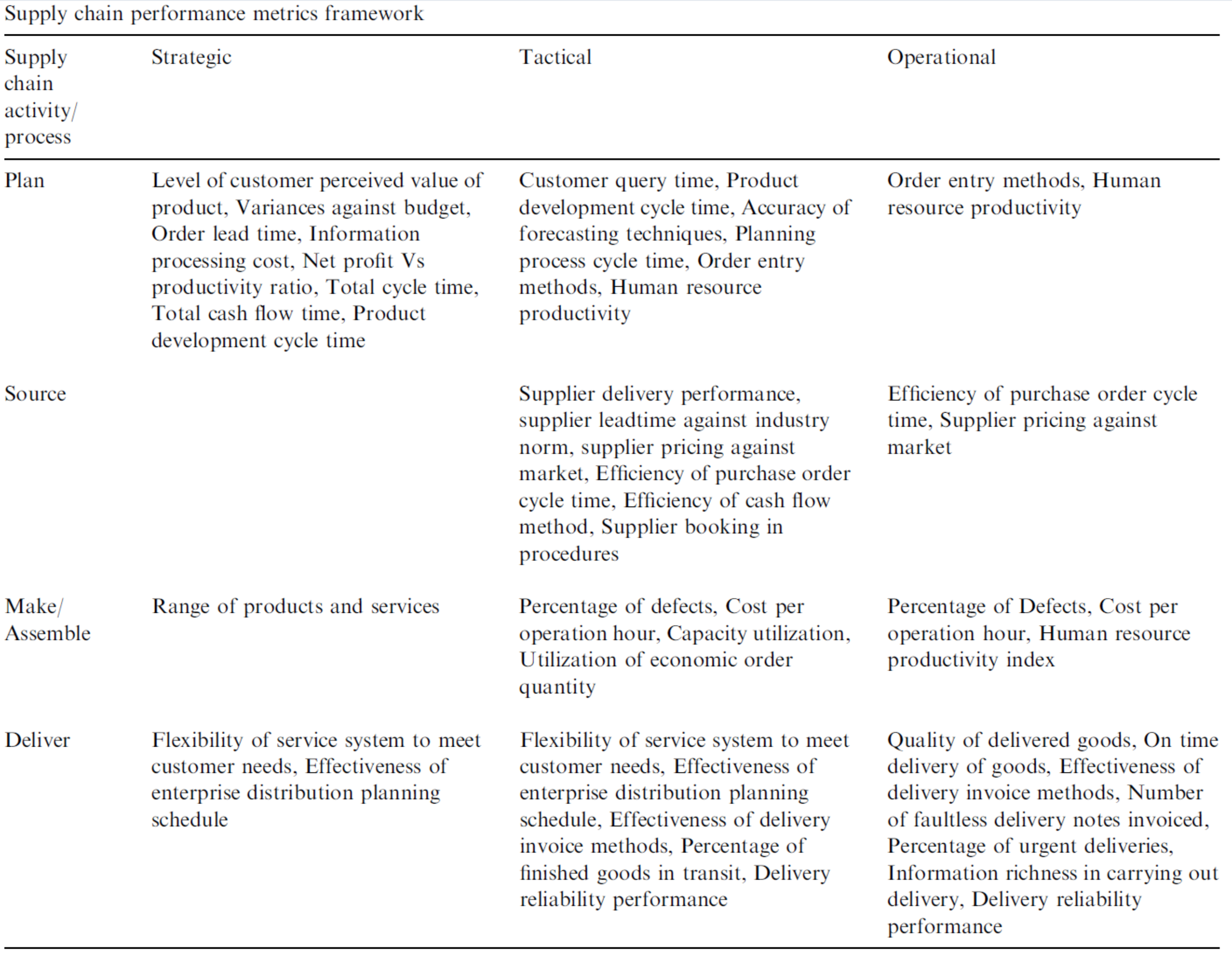


Importance of delivery performance measures

Assessment	Delivery performance metrics	Percentage rating
Highly important	Quality of delivered goods	12.34
	On time delivery of goods	12.20
	Flexibility of service systems to meet customer needs	11.43
Moderately important	Effectiveness of enterprise distribution planning schedule	10.31
	Effectiveness of delivery invoice methods	10.23
	Number of faultless delivery notes invoiced	10.05
	Percentage of urgent deliveries	9.32
	Information richness in carrying out delivery	8.76
Less important	Percentage of finished goods in transit	7.76
	Delivery reliability performance	7.70

Supply Chain Performance Measurement

A. Gunasekaran et al. / Int. J. Production Economics 87 (2004) 333–347

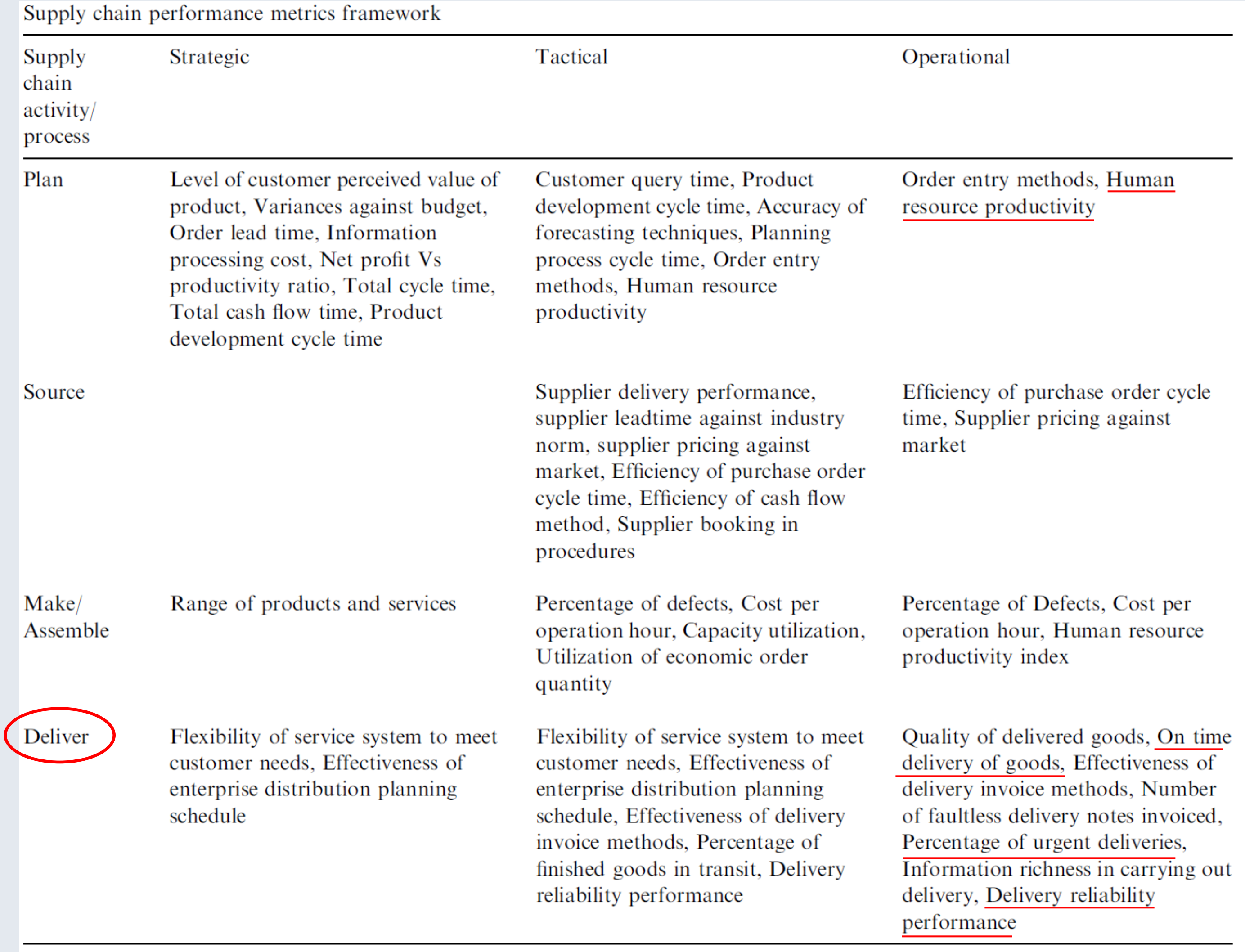


Supply chain performance metrics framework

Supply chain activity/ process	Strategic	Tactical	Operational
Plan	Level of customer perceived value of product, Variances against budget, Order lead time, Information processing cost, Net profit Vs productivity ratio, Total cycle time, Total cash flow time, Product development cycle time	Customer query time, Product development cycle time, Accuracy of forecasting techniques, Planning process cycle time, Order entry methods, Human resource productivity	Order entry methods, Human resource productivity
Source		Supplier delivery performance, supplier leadtime against industry norm, supplier pricing against market, Efficiency of purchase order cycle time, Efficiency of cash flow method, Supplier booking in procedures	Efficiency of purchase order cycle time, Supplier pricing against market
Make/ Assemble	Range of products and services	Percentage of defects, Cost per operation hour, Capacity utilization, Utilization of economic order quantity	Percentage of Defects, Cost per operation hour, Human resource productivity index
Deliver	Flexibility of service system to meet customer needs, Effectiveness of enterprise distribution planning schedule	Flexibility of service system to meet customer needs, Effectiveness of enterprise distribution planning schedule, Effectiveness of delivery invoice methods, Percentage of finished goods in transit, Delivery reliability performance	Quality of delivered goods, On time delivery of goods, Effectiveness of delivery invoice methods, Number of faultless delivery notes invoiced, Percentage of urgent deliveries, Information richness in carrying out delivery, Delivery reliability performance

Supply Chain Performance Measurement

A. Gunasekaran et al. / Int. J. Production Economics 87 (2004) 333–347



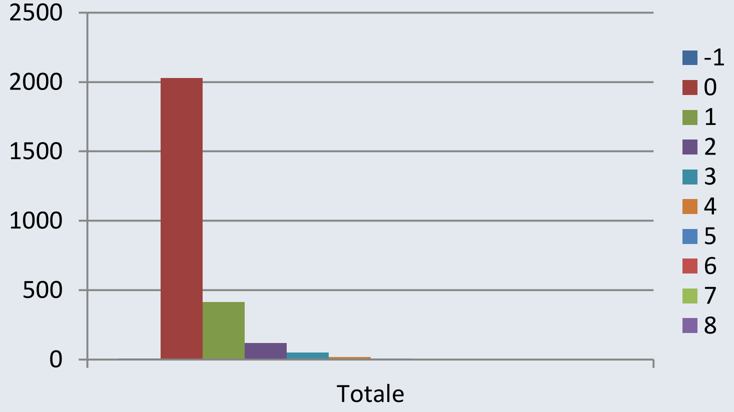
Supply chain performance metrics framework

Supply chain activity/ process	Strategic	Tactical	Operational
Plan	Level of customer perceived value of product, Variances against budget, Order lead time, Information processing cost, Net profit Vs productivity ratio, Total cycle time, Total cash flow time, Product development cycle time	Customer query time, Product development cycle time, Accuracy of forecasting techniques, Planning process cycle time, Order entry methods, Human resource productivity	Order entry methods, Human resource productivity
Source		Supplier delivery performance, supplier leadtime against industry norm, supplier pricing against market, Efficiency of purchase order cycle time, Efficiency of cash flow method, Supplier booking in procedures	Efficiency of purchase order cycle time, Supplier pricing against market
Make/ Assemble	Range of products and services	Percentage of defects, Cost per operation hour, Capacity utilization, Utilization of economic order quantity	Percentage of Defects, Cost per operation hour, Human resource productivity index
Deliver	Flexibility of service system to meet customer needs, Effectiveness of enterprise distribution planning schedule	Flexibility of service system to meet customer needs, Effectiveness of enterprise distribution planning schedule, Effectiveness of delivery invoice methods, Percentage of finished goods in transit, Delivery reliability performance	Quality of delivered goods, On time delivery of goods, Effectiveness of delivery invoice methods, Number of faultless delivery notes invoiced, Percentage of urgent deliveries, Information richness in carrying out delivery, Delivery reliability performance

Human resource productivity

case - study

- **Tempo cumulato sull’attività d’ordine** testata e tutte le righe (relativo quindi alla testata d’ordine), ZTSSCO in secondi
  - Pre-processing: eliminazione ordini in cui uno dei due campi non è valorizzato e se ZTSSCO >28.800 (8 h);
    - Numero ordini esclusi: 0
  - Parametri significativi:
    - numero di ordini: 3.031
    - media 458 sec (circa 7,5 min)
    - tempo cumulato totale circa 385 ore
- **Contatore modifiche testata d’ordine** (relativo alla testata d’ordine), ZTCMOD:
  - Pre-processing:
    - Valori negativi 1
  - Parametri significativi:
    - numero di ordini: 3.031
    - media 0,4
    - grafico distribuzione:

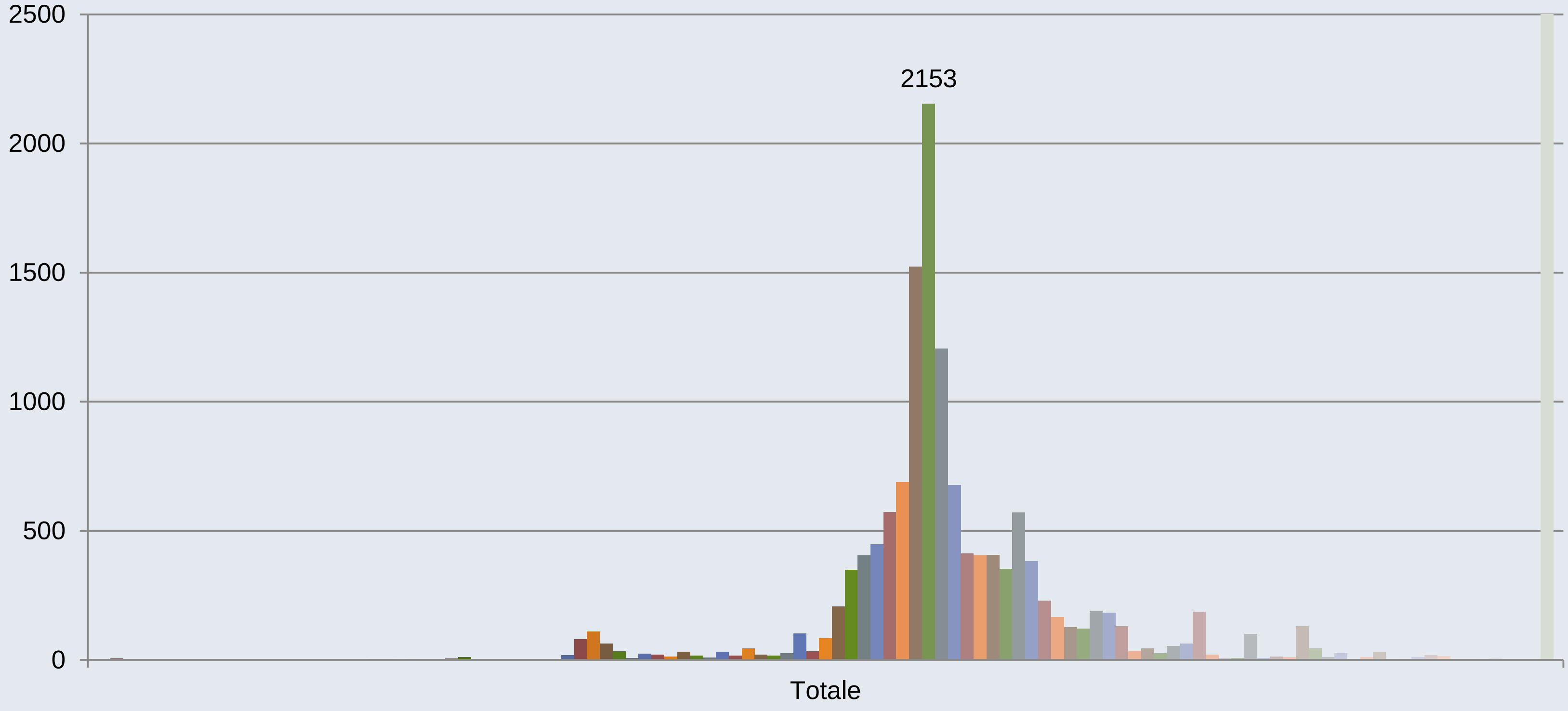


On time delivery of goods – delivery reliability

case - study

KPI6a (rispetto tempi di consegna inclusa spedizione): differenza in giorni tra data di ritiro e data di consegna confermata (relativo alle singole righe d'ordine): ZTDRIT – ZTDACO;

Valore più frequente 0 (data di ritiro uguale alla data confermata)

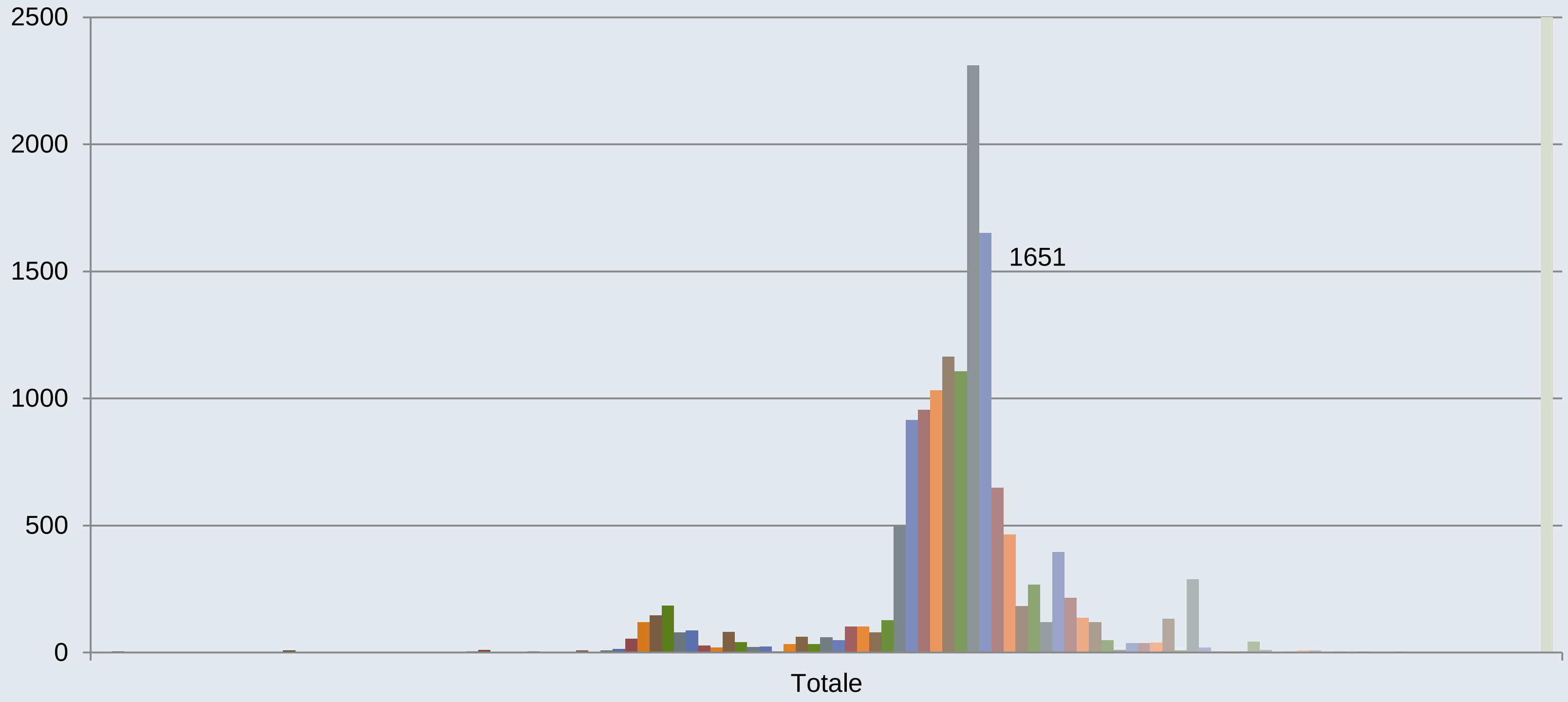


On time delivery of goods - delivery reliability

case - study

KPI7a (rispetto tempi di consegna esclusa spedizione): differenza in giorni tra data di chiusura lista e data di consegna confermata (relativo alle singole righe d'ordine): ZTDCHL – ZTDACO;

Valore più frequente -1 (data di chiusura lista un giorno prima della data confermata)

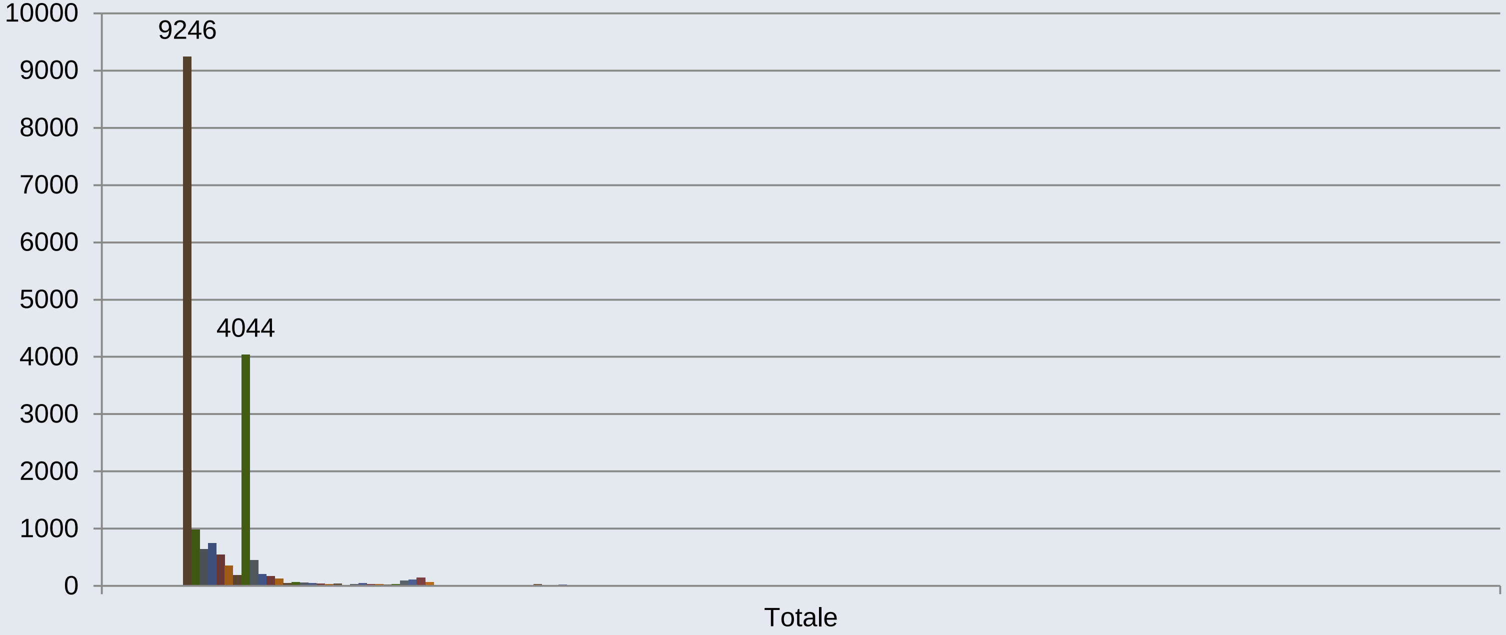


Percentage of urgent delivery

case - study

KPI8a (efficacia di risposta al cliente): differenza in giorni tra data di consegna confermata e la data di consegna richiesta dal cliente (relativo alle singole righe d'ordine): ZTDACO - ZRDARI;

Nota: il picco con valore +7 quantifica gli ordini inseriti oggi x oggi (in quanto la minima differenza inseribile a sistema è 5 gg lavorativi, cioè i +7

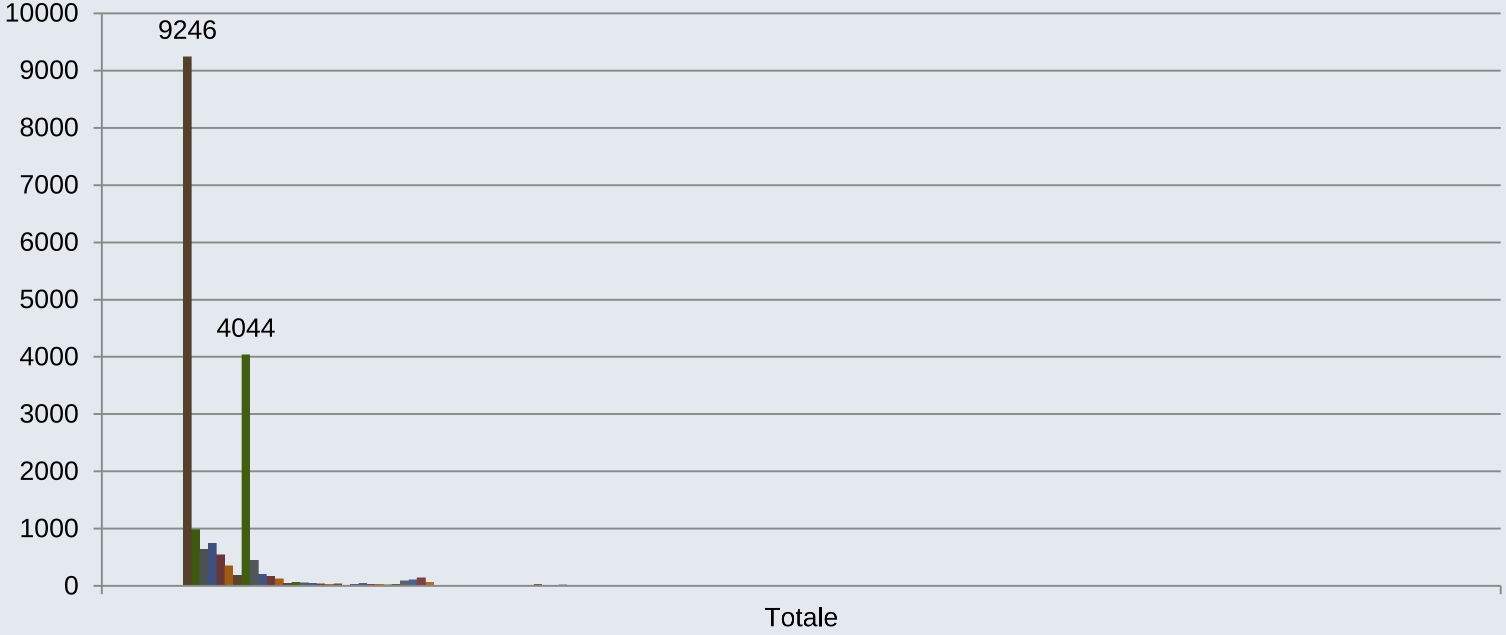


Percentage of urgent delivery - frequency

case - study

KPI8a (efficacia di risposta al cliente): differenza in giorni tra data di consegna confermata e la data di consegna richiesta dal cliente (relativo alle singole righe d'ordine): ZTDACO - ZRDARI;

Nota: il picco con valore +7 quantifica gli ordini inseriti oggi x oggi (in quanto la minima differenza inseribile a sistema è 5 gg lavorativi, cioè i +7

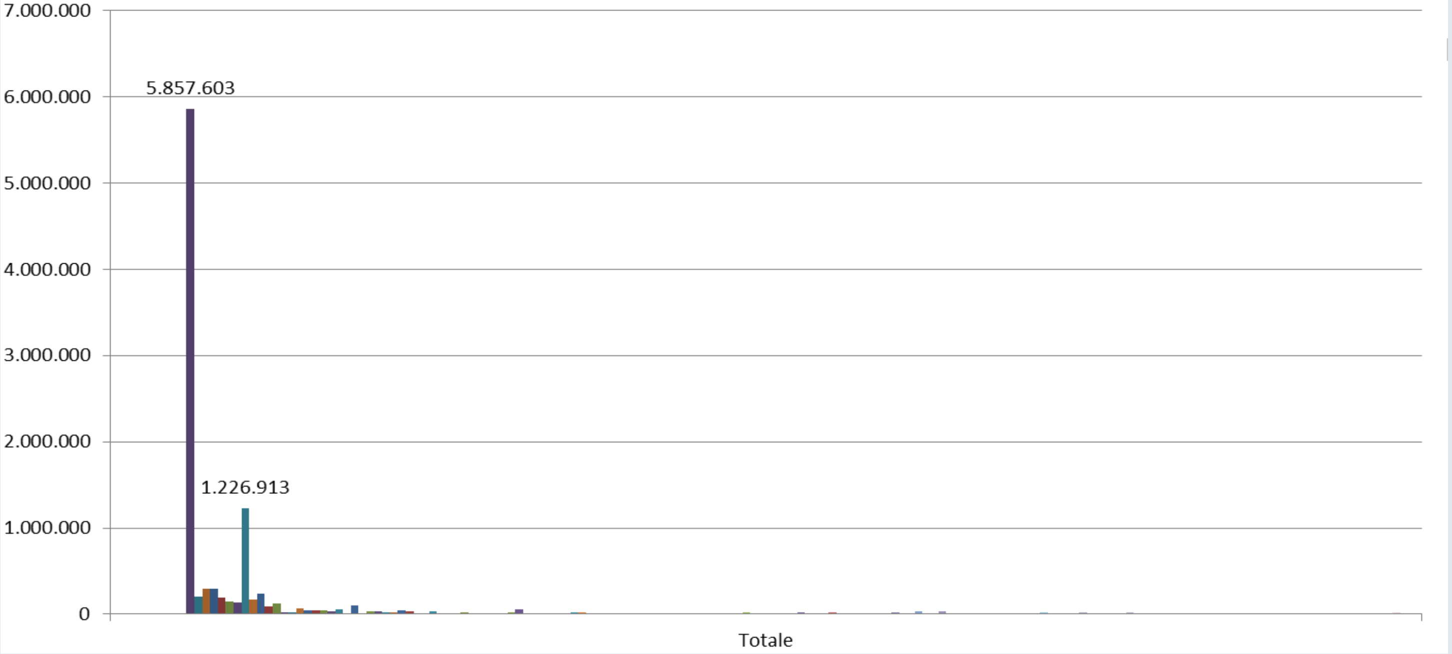


Percentage of urgent delivery – value (€)

case - study

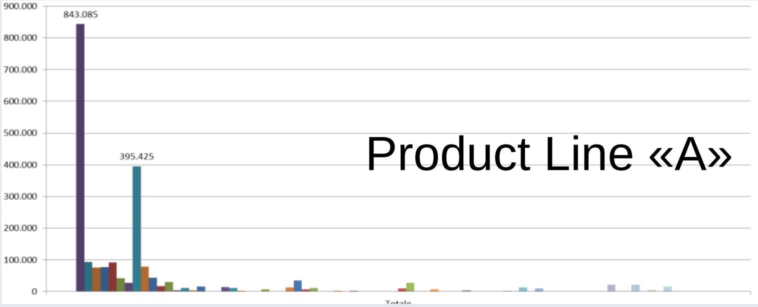
KPI8a (efficacia di risposta al cliente): differenza in giorni tra data di consegna confermata e la data di consegna richiesta dal cliente (relativo alle singole righe d'ordine): ZTDACO - ZRDARI;

Nota: il picco con valore +7 quantifica gli ordini inseriti oggi x oggi (in quanto la minima differenza inseribile a sistema è 5 gg lavorativi, cioè i +7

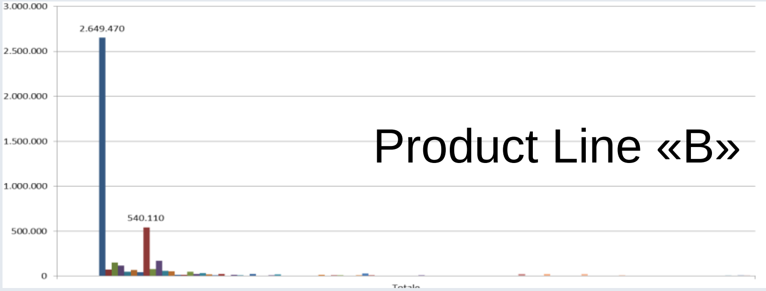


Percentage of urgent delivery – value (€) for product line

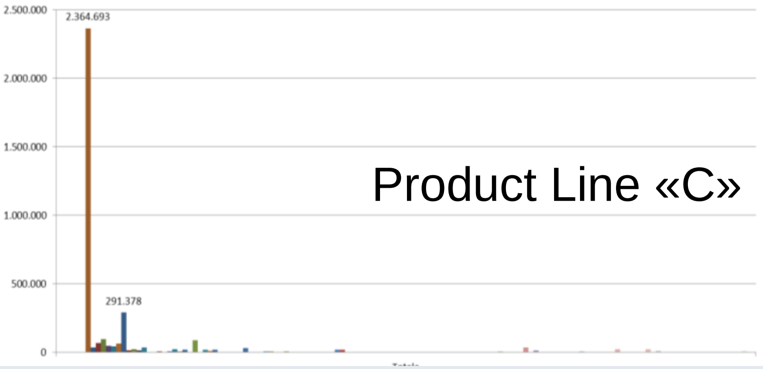
case - study



Product Line «A»



Product Line «B»



Product Line «C»

La percentuale di ordini «urgenti» espressi in valore [€] suddivisi per linea di prodotto risulta significativamente diversa.

L'indicatore (KPI) risulta quindi utile al fine di individuare una particolare linea di prodotti su cui intervenire per migliorare le performance del sistema.