Port Productivity and Role of IT

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Port is a major node in maritime spectrum and can be aptly attributed as 'A maritime intermodal interface'. Whereas other entities in maritime domain are atomic in nature port is simply a collection of activities which makes it more complex in optimizing and quantifying.

Over a period of time, the port management development has seen a striking change in its core attributes, i.e. it has evolved as a logistic platform from a mere transport centre. The summary of differences is tabulated below:

	First Generation	Second Generation	Third Generation	Fourth Generation
Time line	Before 1960	1960-1980	1980-1995	1995 to now
Main cargo	Break Bulk	Break Bulk + Bulk	Bulk and unitised cargo	Unitisation of a large % of the cargo
Strategy for port development	Conservative	Expansionist transport, Industrial and commercial centre.	Commercially oriented. Integrated transport node and logistic centre.	More sophisticated use of automation.
Scope of activities	One ship – shore cargo interface	One / two cargo transformation. Industrial activities.	Multi cargo and info distribution. Full logistic potential	Standardization of information.
Organization characteristic	Atomic in nature / Stand alone	Closer but loose bond between port and user	United and integrated. Privatization started.	Globalisation of port communities and greater environmental control.
Production Characteristics	Cargo flow but low value added.	Cargo flow and transformation. Improved value added.	Cargo + info flow. Multiple service packages. High value added.	Emphasis on quality of service and trained work force.
Decisive factors	Labour / Capital	Capital	Technology / Know - how	**Information Technology.**

(Source: Port Marketing & the Challenges of 3rd Generation Port UNCTAD Report)

To survive and thrive, ports try to attract stakeholders by inducting newer technologies and models, but the primary aim to achieve are:

- Maximize cargo throughput
- Minimize its cost

In spite of various constraints imposed as depicted in below drawing.

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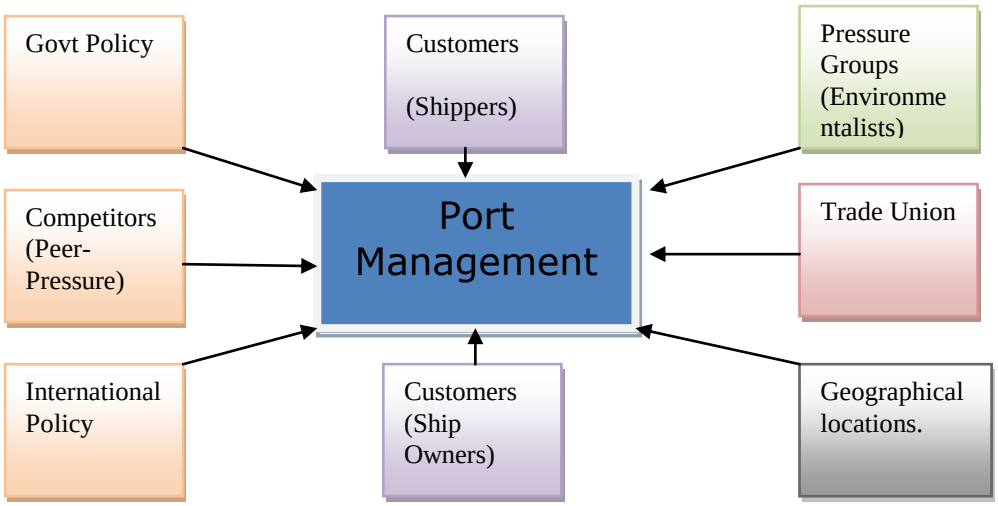

Constraints influencing on port management

Port Productivity definitions

Berth Occupancy Ratio (BOR): This a ratio obtained by dividing the time a berth has been occupied by the time a berth is available during a considered period of time i.e. BOR=Ts / 8760

Where

- **Service Time (Ts)** – it is a period of time during which a vessel is berthed whether the ship works or not. This service time includes both working and non-working time.
- 8760 is a constant – it is the number of hours in a year (leap year not included)

Waiting Time(Wq): is the time a vessel is waiting for an available berth

Waiting Ratio = Wq/Ts

Dwell Time: Is the time spent by the container in the port.

Berth Utilization: Ts / Possible working days

For a median fit, BOR of around 0.7 is considered about right. In case of high ratio, port is facing serious possibilities of congestion and for small ratio indicates possibilities of over investments.

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Productivity

Improve port productivity by minimizing:

- Time
- Cost

during vessel's port stay. One of the indicators for port productivity is BOR and by comparing these against peers will give a clear indication about ones standing.

However due diligence must be exercised while benchmarking productivity by only BOR method because:

- In many terminals with long quay wall there is no determined number of berths
- The time measured varies from port to port (Service time and working time)

'Berth utilization ratio' is also another indicator and these when used with below indicators give a better and more informed result about port productivity.

1. For crane or cargo handling gateway measure the number of boxes moved per crane in both the total ship time on the berth and the working ship time on the berth. It gives Gross and Net productivity level.
2. The number of people employed on terminal concerned with cargo handling can also be measured, as can the equipment. Here annual number of boxes per person per piece of equipment can be measured.
3. The ratio of berth length to number of cranes is a good indicator.
4. Dwell time of a container is another good indicator.
5. Delays and average time lost due to strike for last 5 years will be also a good indicator.

As we have seen from above a numerous data has to be captured to analyse these indicators. So without duplicating a process how can we capture data?

This could be done by:

1. EDC (Electronic Data Capture i.e. RFID / Barcode/ GPS)
2. Each stakeholder enters his / her data in a common platform (Web based solution with database)
3. Proactive validation and intelligent checks (Robust Programming)
4. Mobile users
5. IIVR(Integrated Interactive Voice Response)

With active and automated single point data entry will enhance the process flow and will facilitate for further processing / mining so as to get at Port productivity Key Performance Indicators (KPI)

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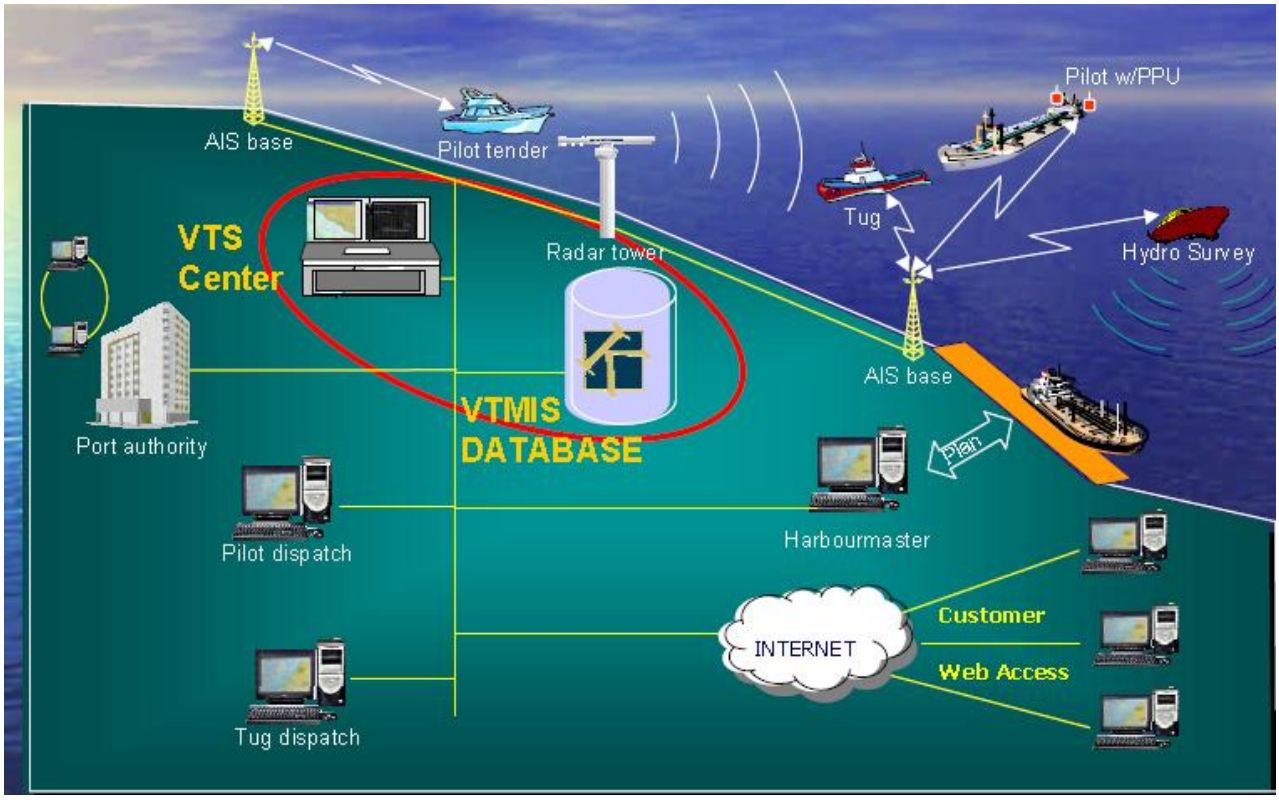

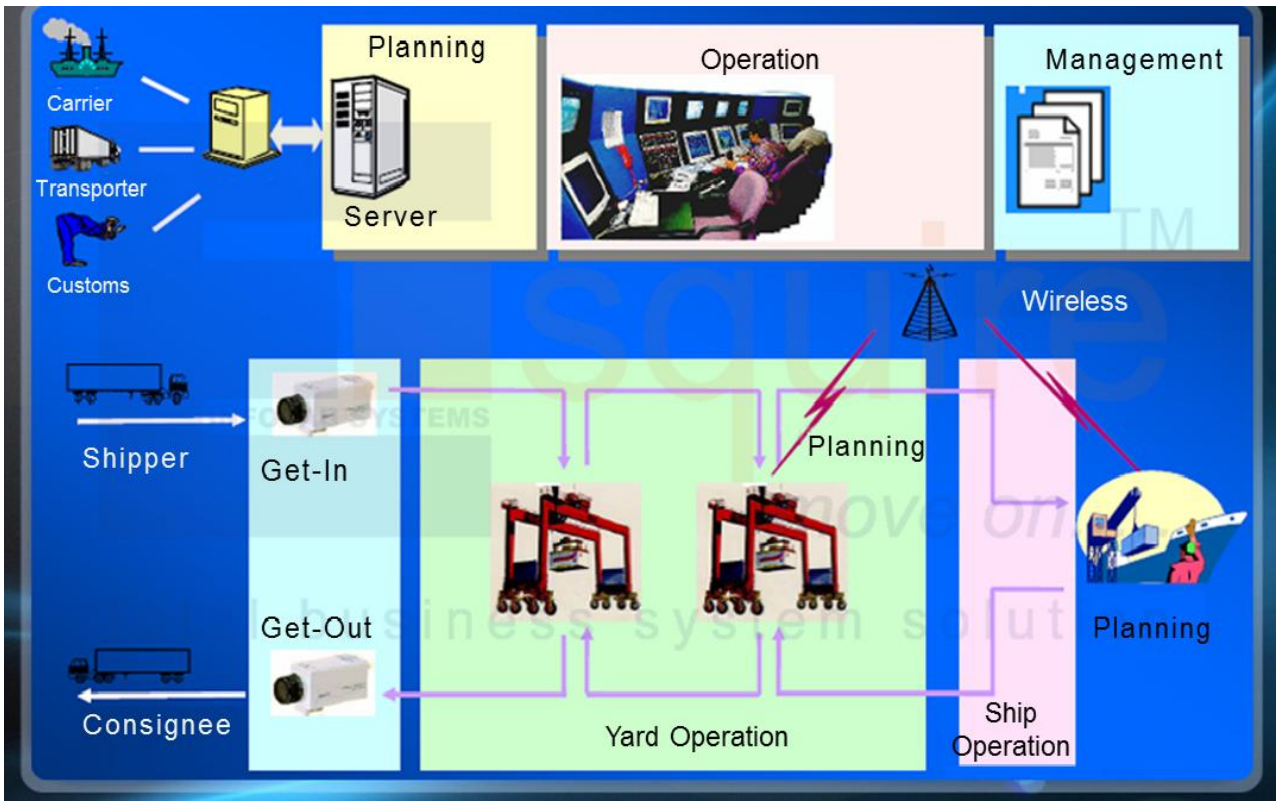

Electronic and automated data capturing

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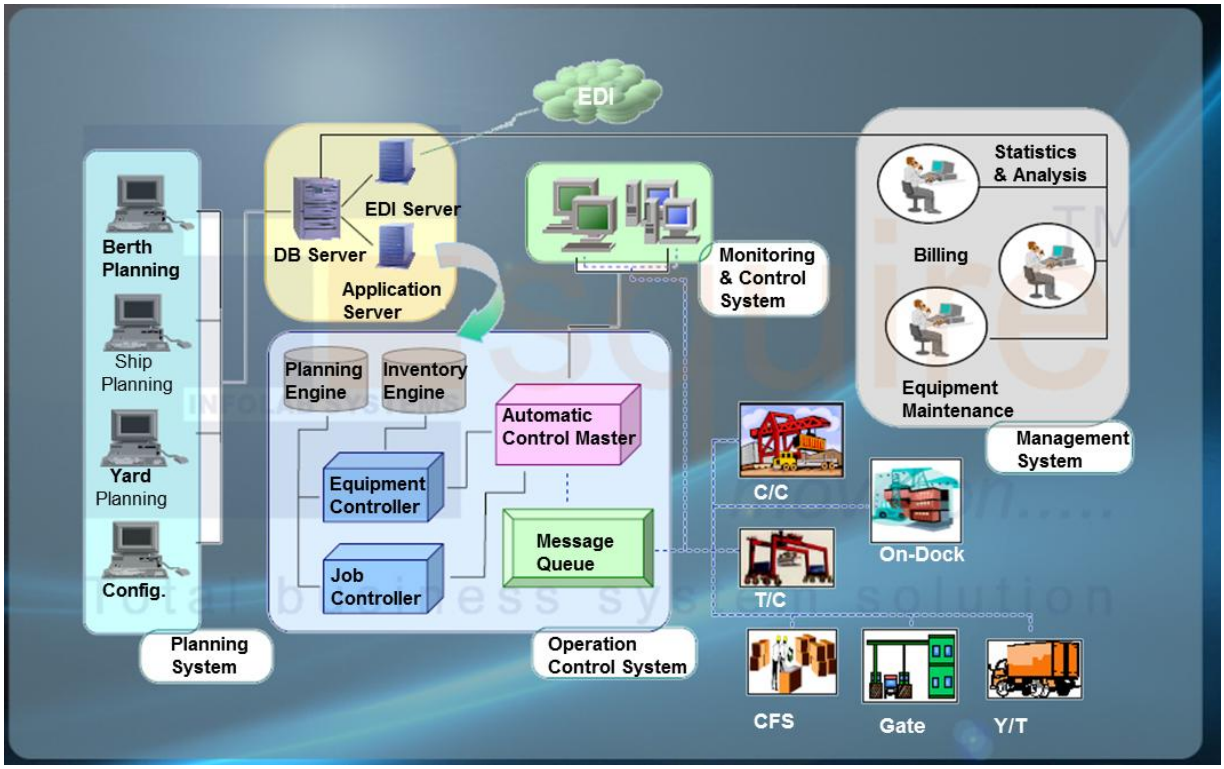
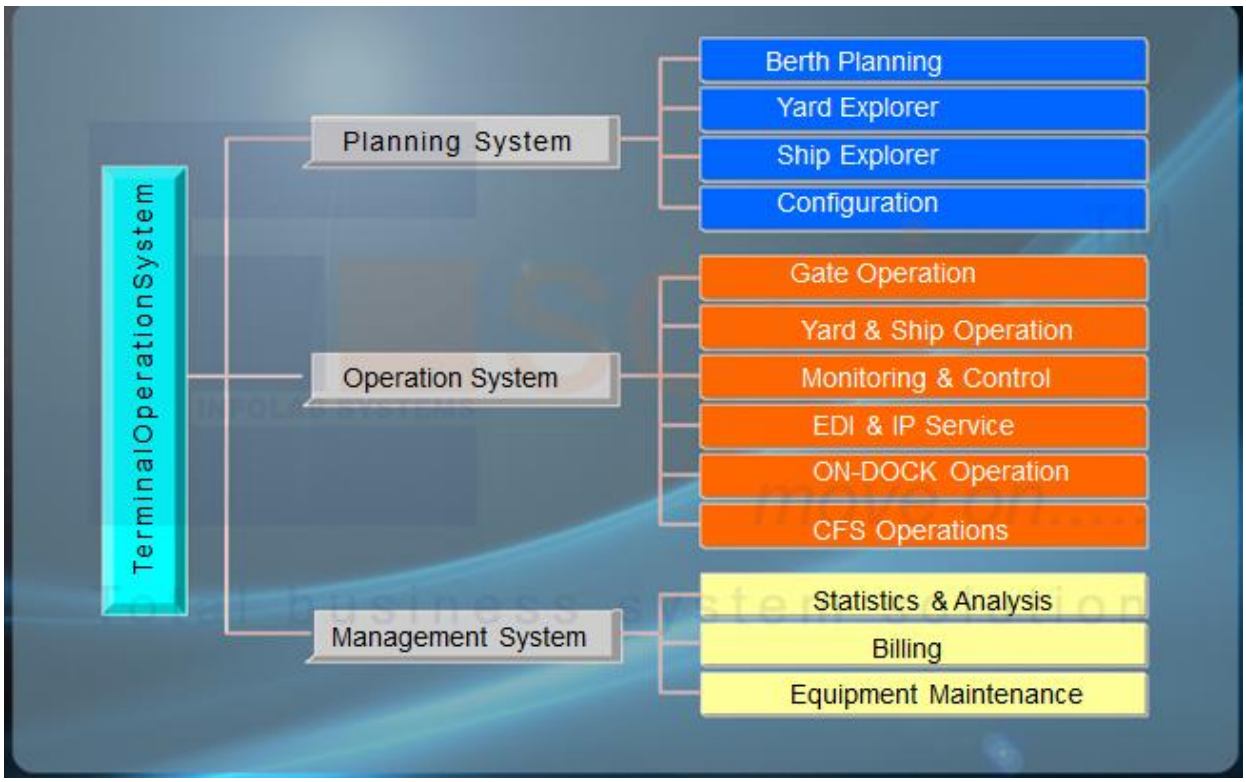


Utilization of IT system in Port Operation



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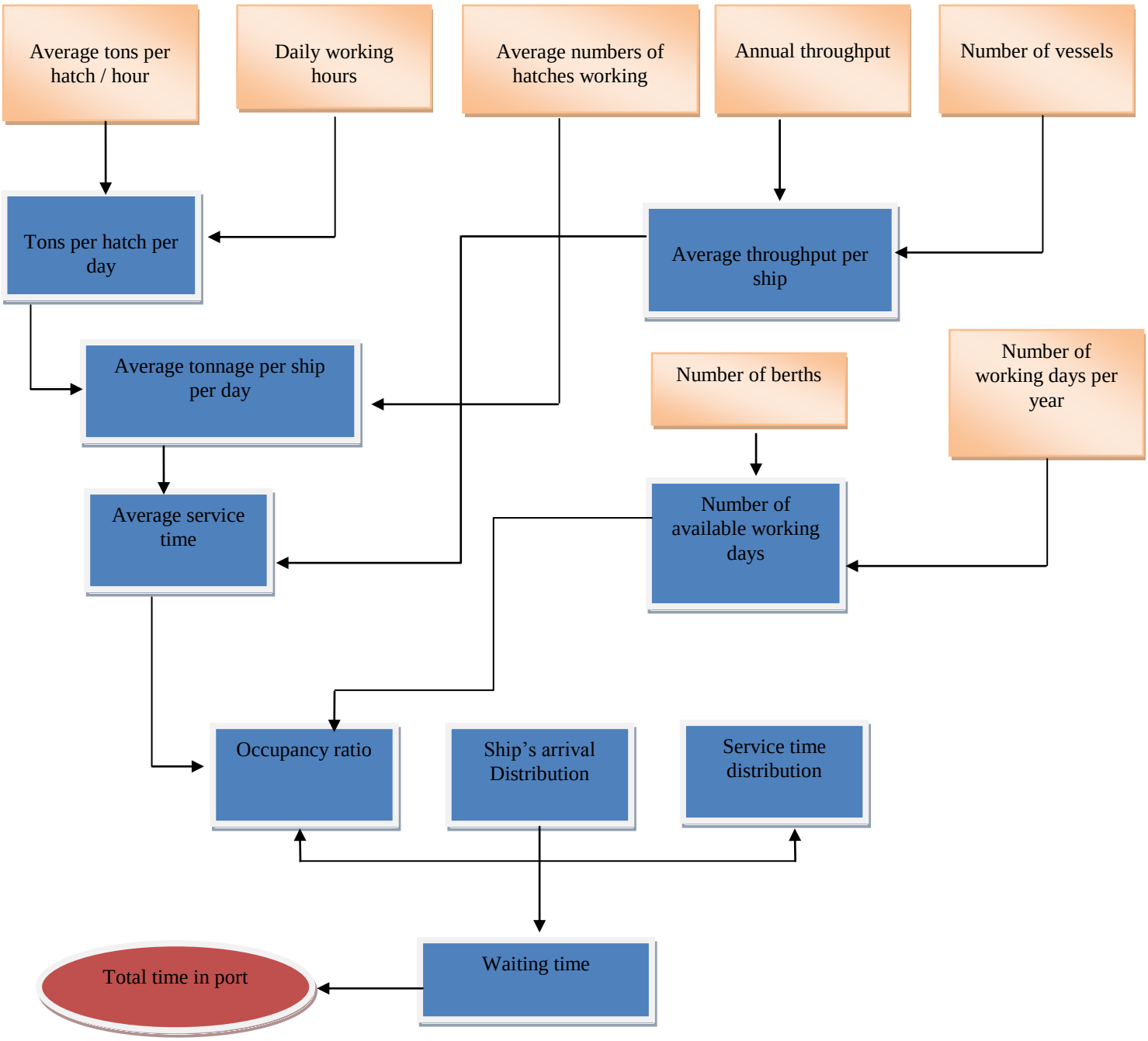
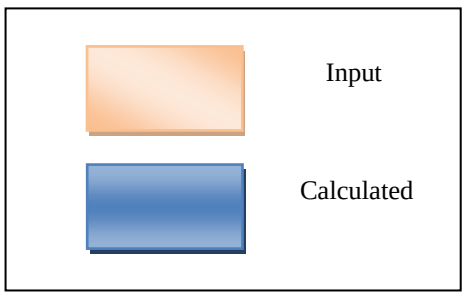


Basic data to be captured for various Port KPIs



Colour Legends

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Monte Carlo Simulation based port statistical data model

Table of Random Numbers**:**

52	06	50	88	53	30	10	47	99	37	66	91	35
37	63	28	02	74	35	24	03	29	60	74	85	90
82	57	68	28	05	94	03	11	27	79	90	87	92
69	02	36	49	71	99	32	10	75	21	95	90	94
98	94	90	36	06	78	23	67	89	85	29	21	25
96	52	62	87	49	56	49	23	78	71	72	90	57
33	69	27	21	11	60	95	89	68	48	17	89	34
50	33	50	95	13	44	34	62	63	39	55	29	30
88	32	18	50	62	57	34	56	62	31	15	40	90
90	30	36	24	60	82	51	74	30	35	36	85	01
50	48	61	18	85	23	08	54	17	12	80	69	24
27	88	21	62	69	64	48	31	12	73	02	68	00
45	14	46	32	13	49	66	62	74	41	86	98	92

Example:

Following long trips down the River from industrial mid-western cities, fully loaded barges arrive in Port. The inter-arrival times for the barges are given in *Dist. 1*. In the same table, the cumulative probabilities and corresponding random number intervals are also given. *Dist. 2.* provides similar information regarding the times taken to unload a barge. Calculate:

- Average Time Between Arrivals (Hours)
- Average Time to Unload (Hours)
- Total Wait Time (Hours)
- Average Wait Time (Hours)
- Average Time in Port

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Example: Dist. 1 – Inter-Arrival Times

Time Between Arrivals (Hours)	Probability	Cumulative Probability	Random - Number Interval
36	0.13	0.13	01 – 13
24	0.17	0.30	14 – 30
12	0.15	0.45	31 – 45
8	0.25	0.70	45 – 70
6	0.20	0.90	71 - 90
4	0.10	1.00	91 - 00

Example: Dist. 2 – Unloading Times:

Unloading Times (Hours)	Probability	Cumulative Probability	Random-Number Interval
24	0.05	0.05	01 – 05
12	0.15	0.20	06 – 20
8	0.50	0.70	21 – 70
6	0.20	0.90	71 – 90
4	0.10	1.00	91 - 00

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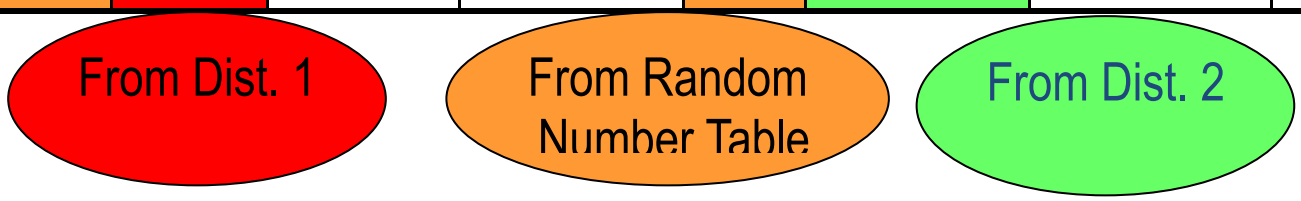
Rn	Int Arr Time	Arrival Time	Unloading Starts	Rn	Unloading Time	Unloading Ends	Waiting Time
52	8	8	8	37	8	16	0
06	36	44	44	63	8	52	0
50	24	68	68	28	8	76	0
88	6	74	76	02	24	98	2
53	8	82	98	74	6	104	16
30	24	106	106	35	8	114	0
10	36	142	142	24	8	150	0
47	8	150	150	03	24	174	0
99	4	154	174	29	8	182	20



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Summary:

Average Time Between Arrivals (Hours)	Average Time to Unload (Hours)	Total Wait Time (Hours)	Average Wait Time (Hours)	Average Time in Port
154/9 hrs	102/9 hrs	38 hrs	38/9 hrs	11.3 + 4.2 hrs
17.1 hrs	11.3 hrs		4.2 hrs	15.5 hrs

Conclusion:

It is clear from above discussion that the port productivity cannot be measured with only predefined KPI but its indicators will change and evolve as per market and dynamics. In above discussion environmental pollution has not been addressed rather only commercial aspects have been discussed. With changing dynamics it will not be possible to capture / data mining such huge and complicated data, without proper IT system. Further it can be safe to say, as the dynamics are changing in port operations and management, there could not be a fixed IT system for this. The system should change as per dynamics and technology to give more value added information to management. In the era of globalization where the stakeholders also require online information, a well thought of flexible IT solution needs be implemented in Port.

Reference:

1. *Port operation management*
2. *Operational Management*
3. *UNTAD Publications*