unit-4:- Syllabus

Data acquiring, organizing and Analytics in IOT/M2M, Applications/services/Business processes, IOT/M2M Data acquiring and storage, Business Models for Business processes in the Internet of things, organizing Data, Transcations, Business processes, Integration and Enterprise system.

✦ IOT/M2M Data acquiring and storage:-

→Data generation:-

Data generates at devices that later on, transfers to the internet through a gateway. Data generates as follows:

i. passive Devices Data:-

→Data generates at the device or system.
→Data following the result of interactions.
→ A passive device does not have own power source.
→ An external source makes that device to send data.
→ RFID or ATM Debit card
→ A contactless card may or may not have an associated micro controller, Memory & trans receiver.

ii. Event data from Device:-

→ Device generating data on an event once only.
→ Detection of the traffic or on dark ambient conditions, that signals an event. Then event communicates a need for the lighting up a group of street lights.
→ System consisting of security cameras generating data on an event of security breach or on intrusion detection.

→ A waste container with associate circuit generating data in the event of getting it 90% or above -filled up.

Active Devices Data:-
→ Data generates at the device or system.
→ Data following the result of interactions.
→ Active device own power resource.
→ Active device associated micro-controller, memory and transceiver.
→ Examples: wireless sensor node, Active RFID's.

iv) Device Real time data:-
→ An ATM generating data and communicates to server instantaneously through internet.
→ Then, intiating and enabling Online Transcation processing (OLTP) in real-time.

v) Event Driven device data:-
→ A device receives command from Controller, monitor and actuator.
→ Then, performs actions using an actuator.
→ when the action completes, then device sends an acknowledgement.
→ Eg:-An application seeks status of a device, then the device communicating the status.

→ Data Acquisition:-
→ Acquiring the data from IOT/M2M devices.
→ The data communicate after the interactions with a data acquistion system (Application)
→ The Application interacts & communicates with number of devices for acquiring the needed data.

→ The devices send data on demand or at the programmed levels intervals.

→ Data of devices communicate using the network, transport and security layers.

→ Device Management software:
   i. provisioning for the device ID or address, activation,
   ii. configuring
   iii. Registering, deregistering
   iv. Attaching, detaching.

Data validation:—

→ Data needs validation checks.

→ Data validation software do the validation checks.

→ Validation software applies logic, rules and Semantic annotations.

→ Must the as the Applications/services/processes depend on valid data.

→ Then only the analytics, predictions/prescriptions/diagnosis/decisions acceptable.

Data categorisation for storage:—

→ Data which needs to be repeatedly processed, referenced or audited in future, and therefore, data alone needs to be stored.

→ Data which needs processing only once, and the results are used at later time using the analytics, and both the data and results of processing and analytics are stored.

→ online, real-time or streaming data need to be processed and the results of this processing and analysis need storage.

Assembly software for the Events:—

A device can generate an event for example, a sensor can generate an event when the temperature reaches at high point (or) at the below point. Each event can be assigned an id. A logical value can be used to set or reset an event state.

i, logic 1 refers an event generated but not acted on the acquired data. where as logic 0 refers an event generated and acted on the acquired data.

ii, A s/w component in an application can assemble the events and can also had data time stamp.

Data store:—
A data store is a data repository of a set of objects which integrate into the store.

Features:—

i, objects in a data-store are modeled using classes which are defined by the database schemas.

ii, A data store is a general concept. It includes data repositories such as database, relational database, flat-file, spreadsheet, mail server, web server and VMware.

iii, A data store may be distributed over multiple nodes, Apache cassandra is an example of distributed data store.

iv, A data store may consist of multiple schemas or may consist of data in only one scheme. Example of any one scheme data store is a relational database.

Data centey Management:—

Data centres also possess a dust-free, heating, ventilation & air conditioning (HVAC), cooling, humidification and dehumidi-fication equipment, pressurisation system with a

physically highly secure environment.

Server Management:-

It means managing the services, setup and the maintanence of the system associated with the server. A server Management includes the following capabilities:

i, short reaction times when the system is down.

ii, optimised performance.

iii, security of systems and protection.

iv, strict documentation and audit of all activilies.

v, Maintaining a confidentiality and privacy of data.

Spacial storage:-

spacial database optimised to store, enables querying the data objects defined in a geometric space, and which is a database for 2d and 3d objects. Topological Coverage, linear networks, triangular irregular networks or other complex structures. A spacial database has the following features:

i, A spacial database can perform geometric constructors

ii, A spacial database can define a shape using Vertices.

iii, A spacial database can perform spacial measurements.

iv, A spacial database can change the existing features to new once using special functions.

2) organizing and Analytics in IoT/M2M and organizing data:-

→ organising data:-

Data can be organised in number of ways. The organization of data can be done in form of objects, files, database.

Database:-
→ A collection of data.
→ The collection organised into tables.

Relational Database:-
→ A collection of data into multiple tables which relates to each other through special fields.

Object Oriented Database:-
→ Is collection of objects.
→ Saved objects in objected oriented design.

Database Management System:-
A slw system, which contains a set of programs specially designed for creation & management of Data stored in Database.

DB Transcation Models: 1) Atomicity:- A transcation must complete in full, treating it as indivisible.

2) Consistency:- That data after the transcations should remain consistent.

3) Isolation:- Transaction between tables isolated from each other.

4) Durability:- After completion of any transcations, the previous transcation cannot be recalled.

Relational Database Transcation:-
The execution of interrelated instructions using relations.

Query processing:- Query processing means using a process getting the results of the query made from a DB.

Distributed DB:-

→ A collection of logically interrelated, co-operating databases over a computer Network.

→ Distributed DB system has ability to access remote sites and transmit queries.

Distributed Query processing:-

→ Query processing operations in distributed databases on same system(or) networked systems.

SQL:-

→ A language for data access control, schema creation and modifications.

→ language for managing the RDBMS.

NoSQL:-

→ No integration with applications that are based on SQL.

→ used in cloud data stores.

→ It consists of non-relational data storage systems.

Extract, transform, load (ETL):-

A system which enables the usage of databases used, especially the ones stored at a data warehouse.

i) obtaining data from homogenous/heterogenous data sources — extract.

ii) Transforming and storing the data in an appropriate structure — Transform.

iii) The structured data load in the final target database or data store or data warehouse — load.

Analytics:-

Data Analytics is the process of examining datasets in order to draw conclusions about the

information they contain. Analytics phases are:

Descriptive Analysis:-

It enables deriving the additional value from visualizations and reports. It enables the following?

1) Actions, such as OLAP for the analytics.

2) Reporting (or) generating spreadsheets.

3) visualisations (or) dashboard displays of the analysed results.

4) creation of indicators, called key performance indicators.

Predictive Analysis - It is Advanced Analytics which enables extraction of new facts and knowledge, and then predicts (or) forecasts. It uses algorithms such as regression, analysis, optimisation and co-relation. Examples are follows:

1) predicting trends

2) undertaking preventive maintenance from earlier models of equipment and device failure rates.

Prescriptive Analysis:-

It enables derivation of the additional value and undertake better decisions for new option(s) to maximise the profits.

3) Transcations:-

→ A collection of operations that form a single logical unit of database.

→ consist of all operations executed between begin & end of transaction.

→ Operations such as connect, insertion, append, deletion (or) modification in a unit of database.

Business Transactions :-

Transactions related in some way to a business activity.

online transactions processing :-

→ processing as soon as data/events generate in real time.

→ used when requirements are availability, speed, concurrency and recoverability in databases for the real time data/events.

Batch transactions processing:-

→ Transactions processes in batches and in non interactive way.

→ when one set of transactions finish the results are stored and next batch is taken up.

Stream transactions:-

→ processing on stream of data using specialized frameworks.

→ Query and transaction processing on streaming data needs specialized frameworks.

→ Eg:- log streams, event streams.

Interactive Transactions processing:-

→ Transactions which involve continual exchange of information b/w the computer and user.

Complex event processing:-

→ Application using capture of a combination of data, timing conditions and efficiently recognise the corresponding events over data streams.

Event stream processing/complex event processing:-

→ Processes tasks on receiving streams of data event

identifies the meaningful pattern from the streams.

→ Detect relationships b/w multiple events.

→ correlating the events data.

→ Builds and manages the event-driven information systems.
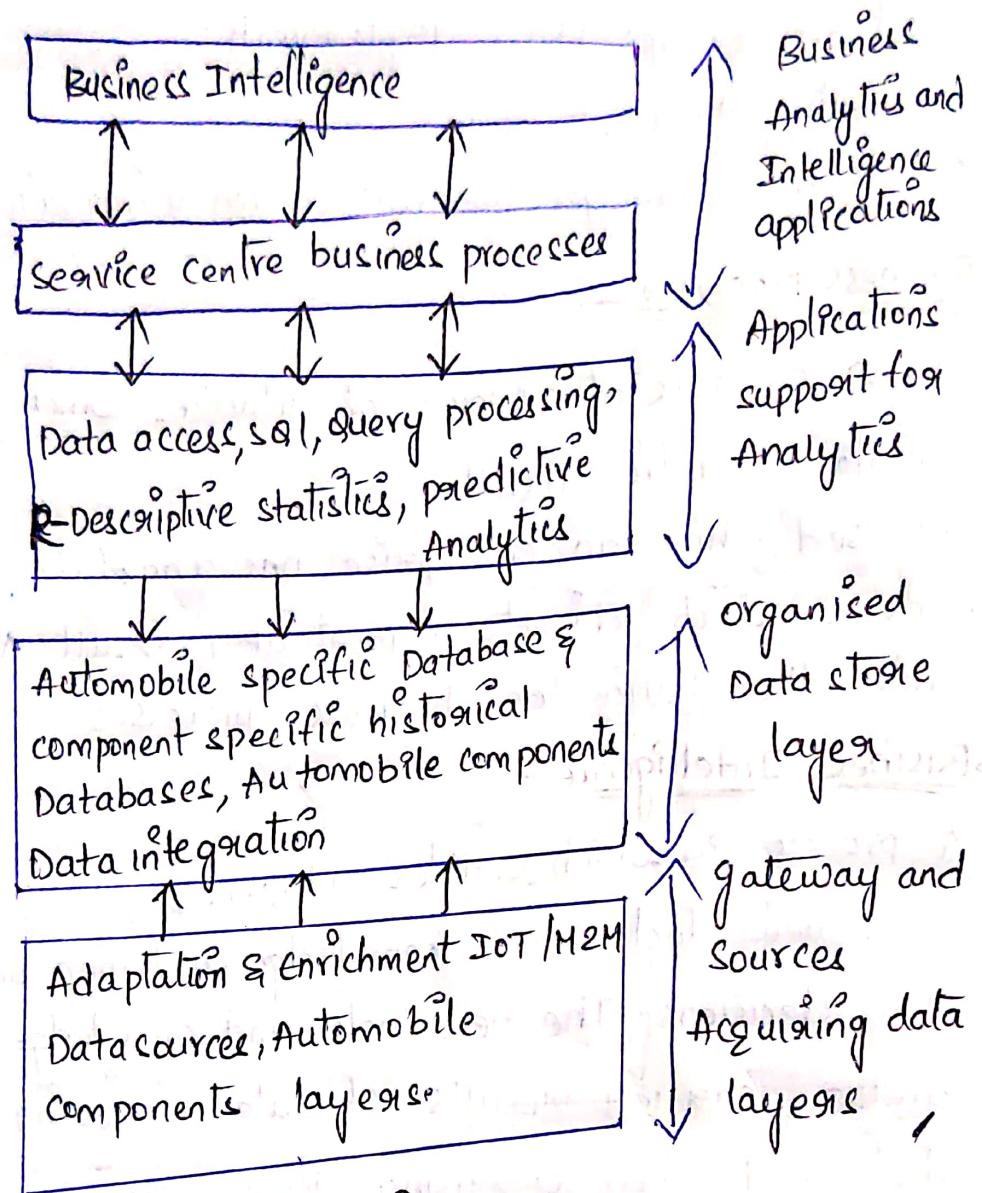
4) Business processes:—

→ A BP consists of a series of activities which serve a particular specific result.

→ It is used, which an enterprise has a no.of inter-related processes which directs a particular result. A IOT/M2M enables the device for business processes.

→ Business Intelligence:—
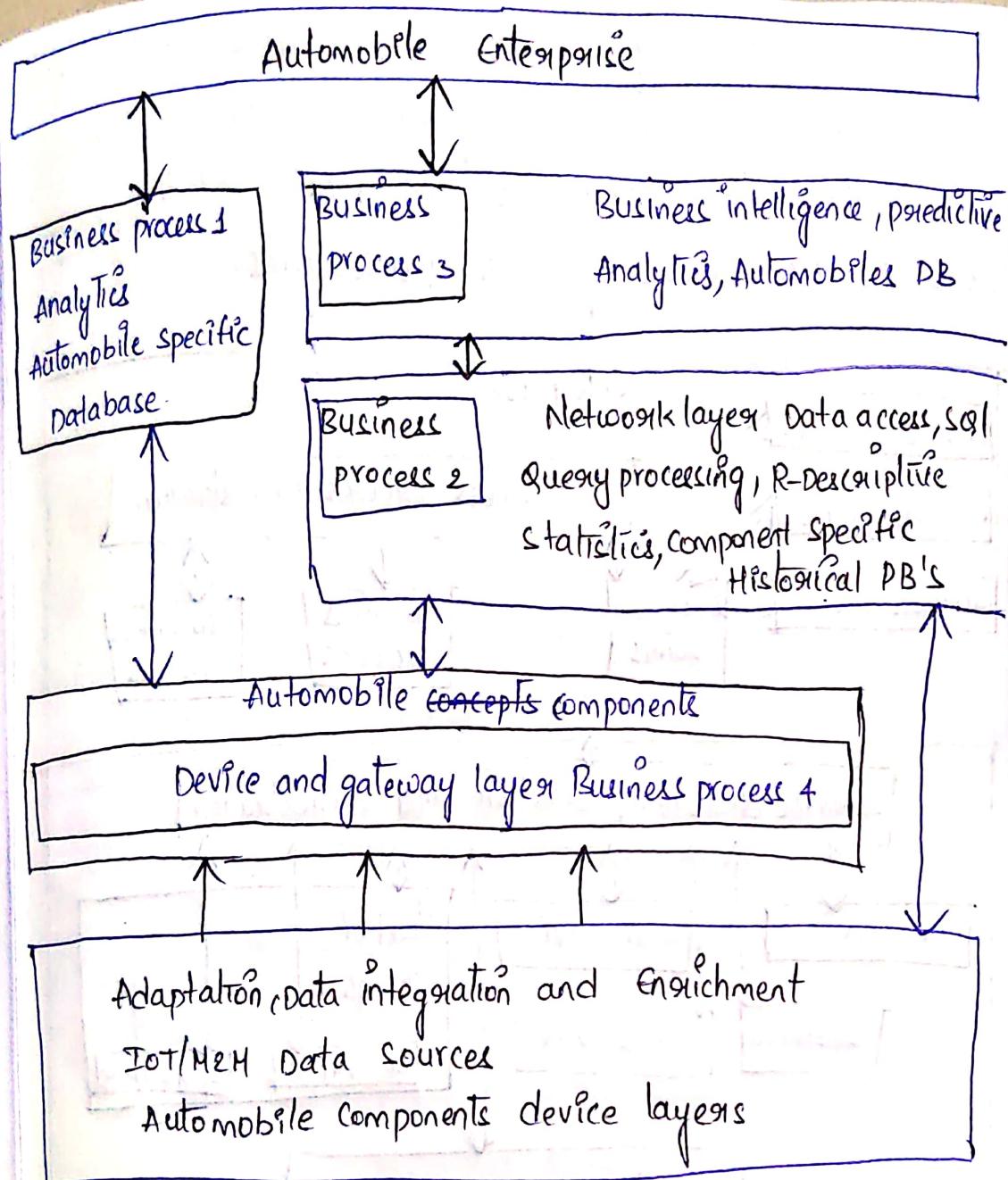
A process in which enables a business service to extract new facts and knowledge and then undertake better decisions. The new facts and knowledge follow from the earlier results of data processing, aggregation and then analysing those results.

The Architecture of business intelligence and business process can be represented as:—

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┌─────────────────────────────────┐        Business
│  Business Intelligence          │        Analytics and
└─────────────────────────────────┘        Intelligence
      ↕      ↕      ↕                       applications
┌─────────────────────────────────┐
│ Service centre business processes│       Applications
└─────────────────────────────────┘        support for
      ↕      ↕      ↕                       Analytics
┌─────────────────────────────────┐
│ Data access, SQL, Query processing,│
│ ↳Descriptive statistics, predictive │
│              Analytics            │
└─────────────────────────────────┘        organised
      ↓      ↓      ↓                       Data store
┌─────────────────────────────────┐        layer
│ Automobile specific Database &   │
│ component specific historical    │
│ Databases, Automobile components │
│ Data integration                 │
└─────────────────────────────────┘        gateway and
      ↑      ↑      ↑                       Sources
┌─────────────────────────────────┐        Acquiring data
│ Adaptation & Enrichment IoT/M2M  │        layers
│ Data sources, Automobile         │
│ Components layers.               │
└─────────────────────────────────┘
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✳ Distributed Business Process:—

→ collection of logically interrelated business processes
    in enterprise Network.

→ A s/w system that manages the distributed BP's

Features:—

→ Co-operation b/w the processes in a transparent
    manner.

→ location independence

→ Enterprise business Intelligence unaware of
    where the processes are located.

→ collection of logically related business processes

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┌─────────────────────────────────────────────────────────────┐
│              Automobile  Enterprise                          │
└─────────────────────────────────────────────────────────────┘
       ↕                    ↕
┌──────────────┐   ┌──────────┐   Business intelligence, predictive
│Business process 1│ │Business  │   Analytics, Automobiles DB
│                  │ │process 3 │
│Analytics         │ └──────────┘
│Automobile specific│        ↕
│                  │   ┌──────────┐   Network layer Data access, sql
│Database          │   │Business  │   Query processing, R-Descriptive
└──────────────────┘   │process 2 │   Statistics, Component Specific
                       └──────────┘              Historical PB's
     ↕              ↕
┌─────────────────────────────────────────────────────────┐
│     Automobile concepts components                      │
│  ┌────────────────────────────────────────────────┐     │
│  │ Device and gateway layer Business process 4     │     │
│  └────────────────────────────────────────────────┘     │
└─────────────────────────────────────────────────────────┘
     ↑        ↑        ↑                              ↕
┌─────────────────────────────────────────────────────────┐
│  Adaptation, Data integration and Enrichment           │
│  IoT/M2H Data Sources                                   │
│     Automobile components device layers                 │
└─────────────────────────────────────────────────────────┘
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5) Integration and Enterprise system :-

A complex application Integration architecture of an enterprise system can and SOA of cloud-based IoT services, web and cloud services.

process orchestration means a number of business processes running in parallel or the number of processes running in a sequence. The process matrix provides the decision points which indicates which process should be run in parallel and which is run in sequence.

A SOA (simple object Access) Service models the no. of Services in these internal relationships.

The service discovery and selection - slso component select the services for application integration. service orchestration slso co-ordinates the execution of the no.of services, cloud services and services.

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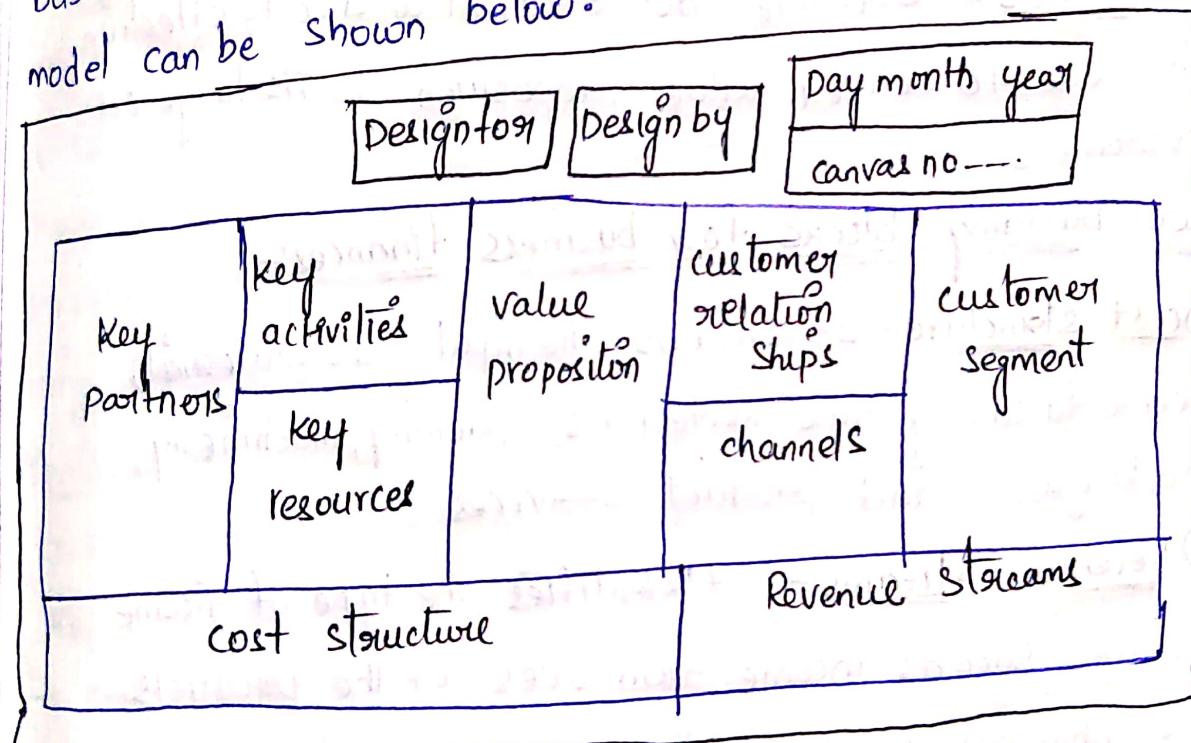
6) **Business Models for business processes in IoT:—**

The Business Models can be continue to grow since ancient times, the ancient time business models are share the resource with one another.

→ A BM now-a-days taken into the consideration many factors such as competative advantage, volume change, theory of portfolio of products and services and competition of business organizations and their plans.

→ A business model can be defined as an abstraction representation may be a conceptual, textual (or) graphical.

Working:— A popular way of generating/working a business model is using a "canvas". The canvas was designed and developed by alexander Oster wlander and his Co-workers.

It is a single reference Model. The main purpose is the conceptualization, similarities of a wide range of business models. The 9 building blocks of canvas business model can be shown below.

Design for	Design by	Day month year
		Canvas no —.

Key partners	Key activities	value proposition	customer relation ships	customer segment
	key resources		channels	
cost structure			Revenue streams	

For business Infrastructure building blocks:—

1) **key partners:—** Strategic Alliances blw Competitors/non-Competitors to optimize the operations and reduce risks of a business model.

2) **key activities:—** key activities to execute a company's value proposition.

3) **key resources:—** Examples are, customer segments, human & intellectual, physical, financial.

Four building blocks are business offerings:—

1) **value propositions:**— products & services offered their features such as performance, efficiency, price, cost, usability.

2) **customer relationships:**— Identified type of relationship of the company to be created with their customers and targeted segments.

3) **customer segments:**— Identified sets of customers, segments, client and diverse groups.

4) **channels:**— Effective, fast, efficient and cost-effective. channels to deliver value proposition to its targeted customers.

Two building blocks for business finances:—

1) **cost structure:**— It contains the input raw material, manufacturing raw materials, packing, machinery, replacement and product services.

2) **Revenue streams:**— It identifies the type of income Sources such as income from sales of the products and physical goods and service usage charges//

* **Business Model Innovation:**—

It is the development of new and different concepts for supporting an organisation financial services. the primary goal is to identify the new revenue source by improving the product value.

A Business model needs innovation because:
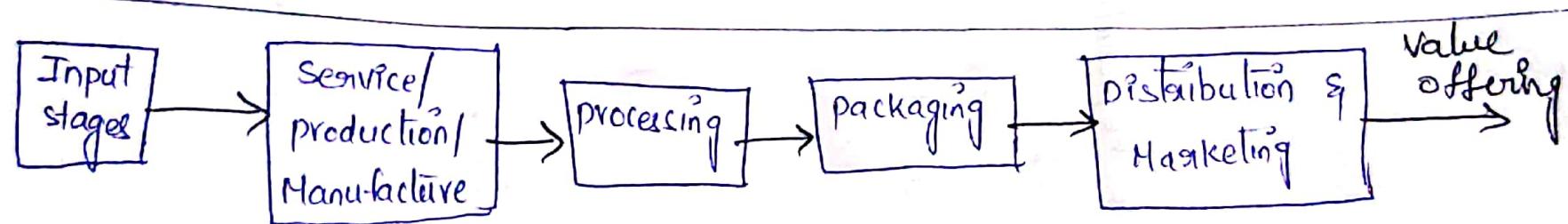
1) New access path to business and direct interaction with the customers.

2) The direct interaction with the customers can allow to decrease the cost of the product.

3) Business transactions have become easier

4) New products will be worked out in competitive environment.

* Value proposition in the IoT:-
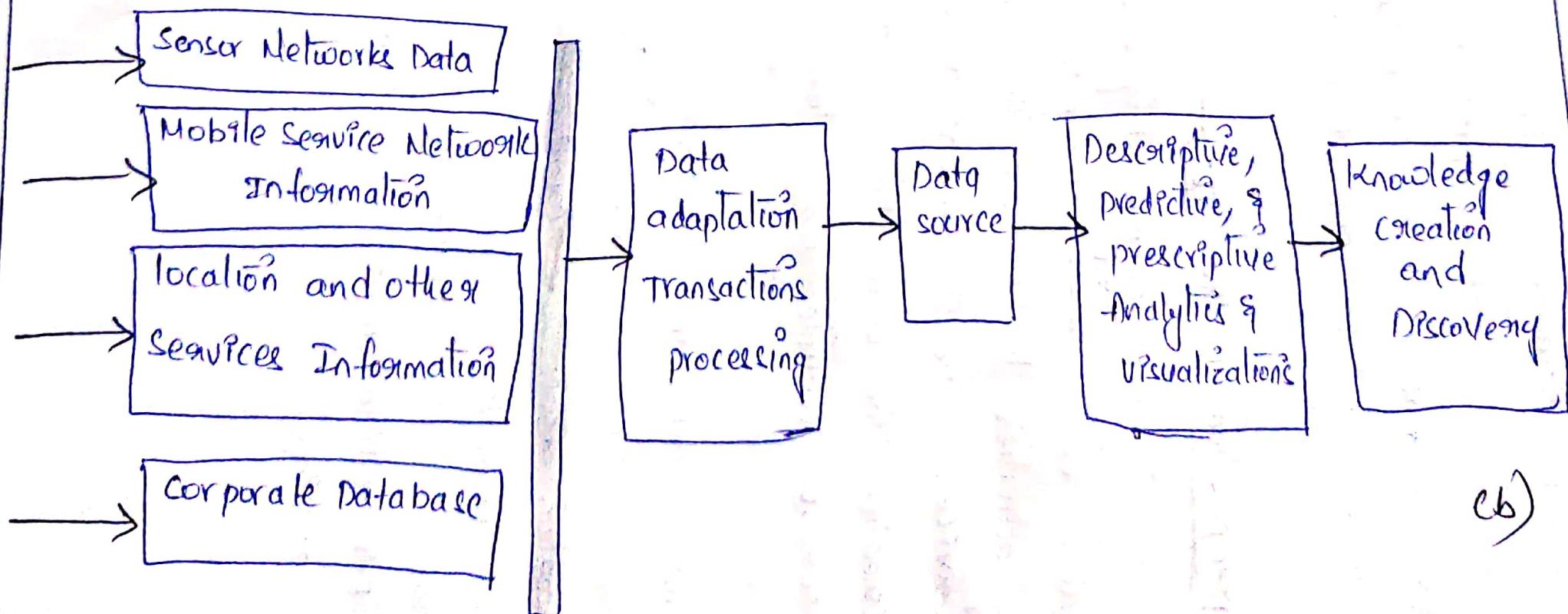
It means producing product/providing services to the product. Value creation is the ~~heart~~ part of any BM. It involves performing activities that enhance the value of a companies product/services. Value chain means a series of actions for value creation. The value chain data can be collected using sensors (or) multiple information sources.

features:-

→ IoT enables addressing the emergent needs and real-time needs using predictive analysis.

→ Information convergence creates new experiences for current products.

→ IoT enables value capture and thus recurrent revenue.

→ Adds personalization and context and uses networked products/services.

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┌──────────┐      ┌──────────────┐                                                      Value
│  Input   │      │  Service/    │     ┌────────────┐    ┌───────────┐    ┌──────────────┐  offering
│  stages  │─────▶│ production/  │──▶  │ processing │──▶ │ Packaging │──▶ │ Distribution │─────▶
│          │      │ Manu-facture │     └────────────┘    └───────────┘    │ & Marketing  │
└──────────┘      └──────────────┘                                        └──────────────┘
                                                                                              (a)
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   ┌──────────────────────────┐
──▶│  Sensor Networks Data    │    ║
   └──────────────────────────┘    ║
   ┌──────────────────────────┐    ║    ┌──────────────┐                      ┌────────────────┐
──▶│ Mobile Service Network   │    ║    │     Data     │    ┌──────────┐      │  Descriptive,  │    ┌────────────┐
   │     Information          │    ║    │  adaptation  │    │   Data   │      │  Predictive, & │    │ Knowledge  │
   └──────────────────────────┘    ║──▶ │              │──▶ │  source  │──▶   │  prescriptive  │──▶ │ creation   │
   ┌──────────────────────────┐    ║    │ Transactions │    └──────────┘      │  Analytics &   │    │ and        │
──▶│ location and other       │    ║    │  processing  │                      │ Visualizations │    │ Discovery  │
   │ Services Information      │    ║    └──────────────┘                      └────────────────┘    └────────────┘
   └──────────────────────────┘    ║
                                   ║
   ┌──────────────────────────┐    ║
──▶│  Corporate Database      │    ║                                                                       (b)
   └──────────────────────────┘    ║
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* Business Model Scenarios for IoT:-

→ sensors, M2M, sensor networks data and the data using web APIs for multiple information sources data, open data, mobile services network information data, corporate database and knowledge database are the input stages.

→ The data from multiple sources and services are part of the key resources in business model scenarios for IoT.

M2M/IoT Devices/ sensor Networks Data		Events & Messages	Event processing	Event Analytics	Real-time Monitoring
Mobile, location & other services Information		Data adaptation transactions processing	Data store	Descriptive, prescriptive & predictive analysis & visualizations	Service/ production/ Manufacture
Corporate DB					Knowledge creation and Discovery
Knowledge DB					
Input stages					output stages