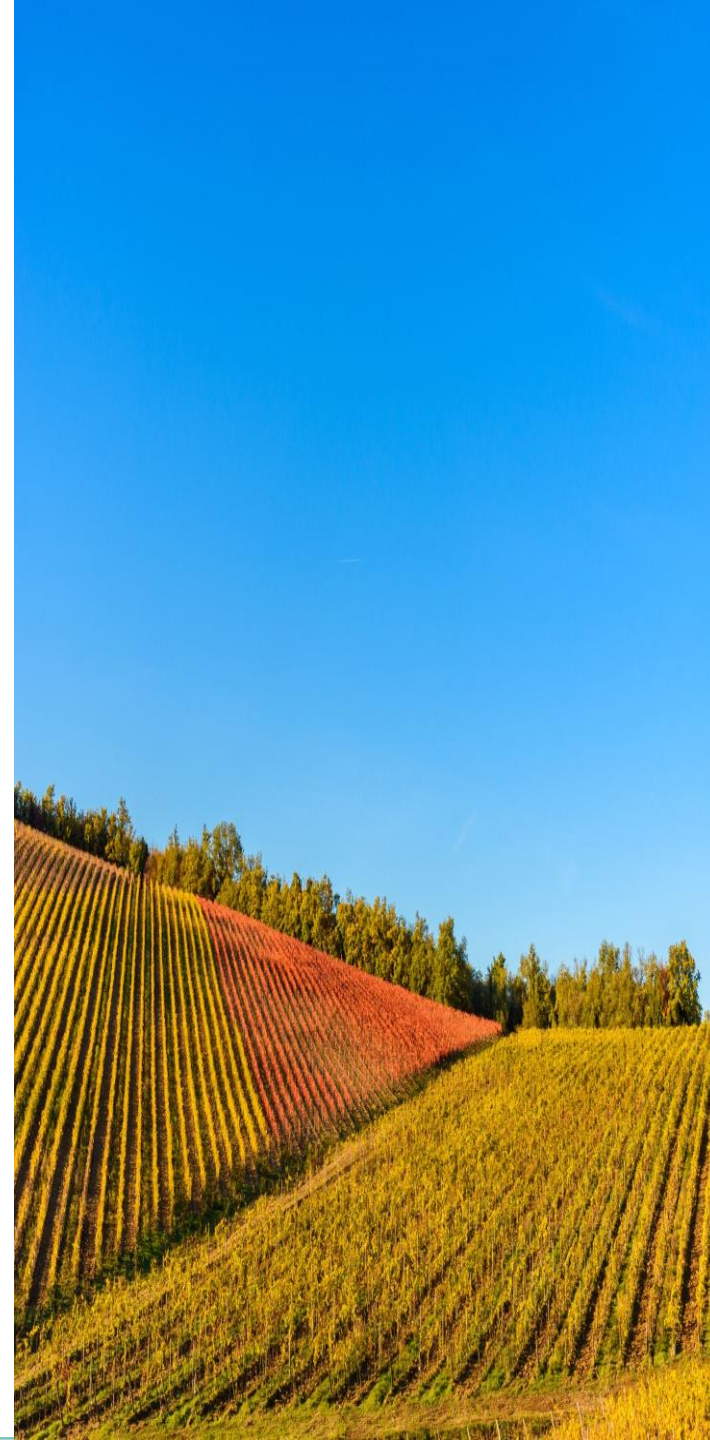


End to End Traceability and Farm Predictability Solution

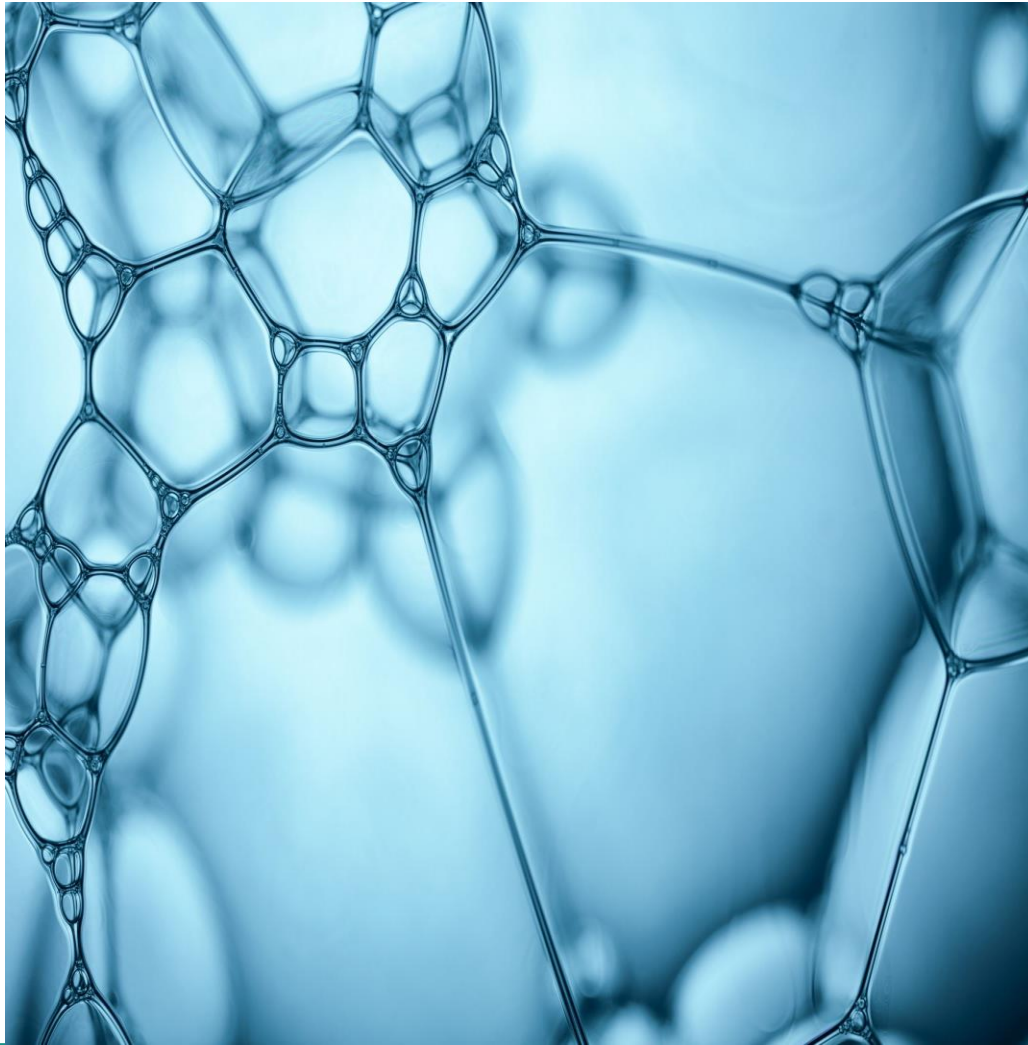
by Grus & Grade Pvt. Ltd.

March 23, 2021 . GRUS & GRADE

Advanced AI, IoT & Blockchain Powered End- to-End Farm Produce Traceability and Predictability Enterprise Solution



DISCUSSION OUTLINE



Contents

- Core Issues
- Background
- G & G Enterprise Solution (POC)
- Need Analysis
- Solution Matrix
- Technical Specifications
- Increase in Net Value
- Team Composition
- Timelines
- Commercials

CORE ISSUE

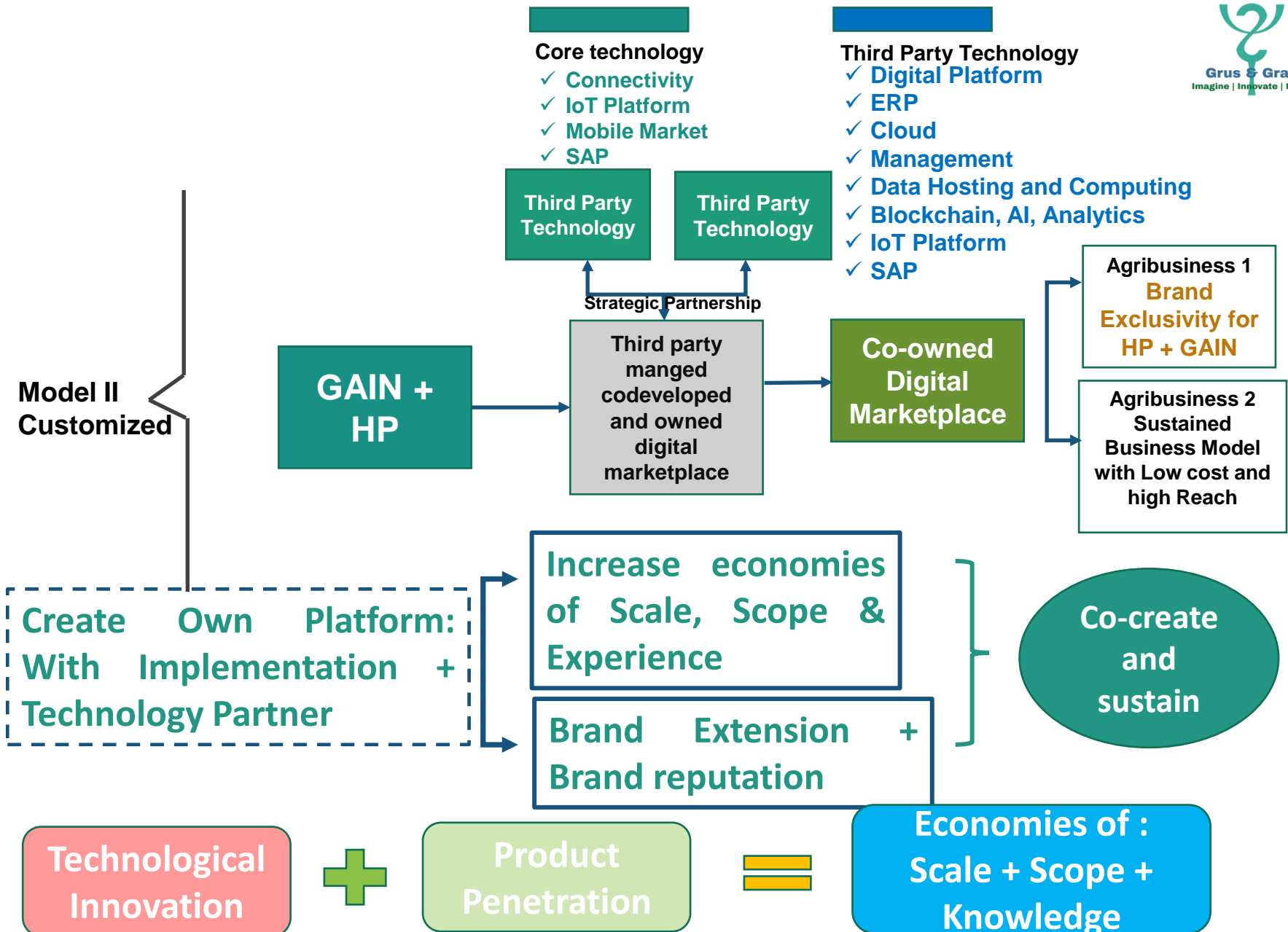
- Lack of traceability solution for biofortified food grains across the food supply chain
- Lack of trust at intermediate level of the food supply chain, real time access to data and accuracy of data
- Lack of confidence to millers and processors about quality, quantity and timelines
- No incentives or a very nominal incentive to farmers growing biofortified crops
- Insufficient information about Crop Yield, Soil Quality, weather & farming insights for farmers
- Harvesting and transportation and aggregation scheduling
- Challenges for commercialization of biofortified food grains and a self sustainable business model for HarvestPlus

G & G Enterprise Solution (POC)

Background :

Strategic Decision: Long Term Strategy Adopt Model –II

Grus & Grade had conducted a detailed research on behalf of GAIN & HarvestPlus for 'Digitalization of Agri-Value chain for commercialization of biofortified food grains.' As a key recommendation of the above research, we had suggested end to end traceability using blockchain, IoT and AI tools for transformative and sustainable agricultural practices and improved and transparent agri supply chain.



INDUSTRY 4.0



Application of Industry 4.0 in
Procurement Management Solution

Procurement Management & Traceability Solution

- Artificial Intelligence & Blockchain based end-to-end solution for storage, query of product information
- Advanced cloud-based data management & analytics
- Predictive Crop Yield, Soil Quality, weather & farming insights for farmers
- AI powered harvesting and transportation and aggregation scheduling

Grus & Grade

Key Deliverables



AI in Procurement

Definitions

AI : Artificial intelligence algorithm exhibiting any behaviour considered smart

ML: Machine Learning algorithm that detects patterns and uses them for prediction & decision making

NLP : Algorithm that can interpret, transform and generate human language

RPA: Robotics process automation that mimic human action to reduce repetitive simple task



RPA

Improve
operations

Identify new
opportunities

Identify new
suppliers &
market

Make better
decisions

Automate
manual tasks

Capture & apply
scarce knowledge

Yield Prediction
Soil & Whether

Demand &
Supply Forecast

Demand &
Supply Forecast

AI with Blockchain: The Winning Combination

Blockchain Transactions

- Central database of records which are linked and secured using encryption
- Digital ledger in which transactions, financial and other documents, will be recorded and processed securely and permanently. This ledger will have user authentication-based access
- It will provide a way for all certification and documentation to be gathered in one place that is accessible to all parties but impossible to falsify.
- Blockchain technology combined with cryptography is proposed to realize the safe sharing of private information in the blockchain network

Blockchain Use Cases

- Data captured for crop details during harvesting cannot be altered when supplied to factories.
- Any alteration attempted will be immediately notified to the respective stakeholders.
- Certification provided after Crop/ soil quality assessment will be recorded in the Procurement system and cannot be altered.
- Procurement system billing transactions related to 3rd party vendors will be secured.
- Emphasis on an analysis of the RFID system, middleware, and applications such as mobile phone or wireless PDA of internet of things

Components of Blockchain Infrastructure

- Understanding of the present shortcoming of current agricultural product traceability and proposed solution.
- Application of Blockchain, IoT and AI technology to enhance the traceability of agricultural product on real time basis. The proposed solution eliminates heavy load, slow query speed and data privacy protection through blockchain technology. The detailed design of the onchain and off-chain storage structure and privacy data protection will be key part of the enterprise solution by Grus & Grade.
- We build blockchain environment based on Hyperledger Fabric and use python to develop and implement traceability. Application of TensorFlow for image processing and NLPs, Angular, GUI & Github technological framework for simpler and user-friendly user interface and user experience.

Components of Blockchain Infrastructure

Design of the traceability system

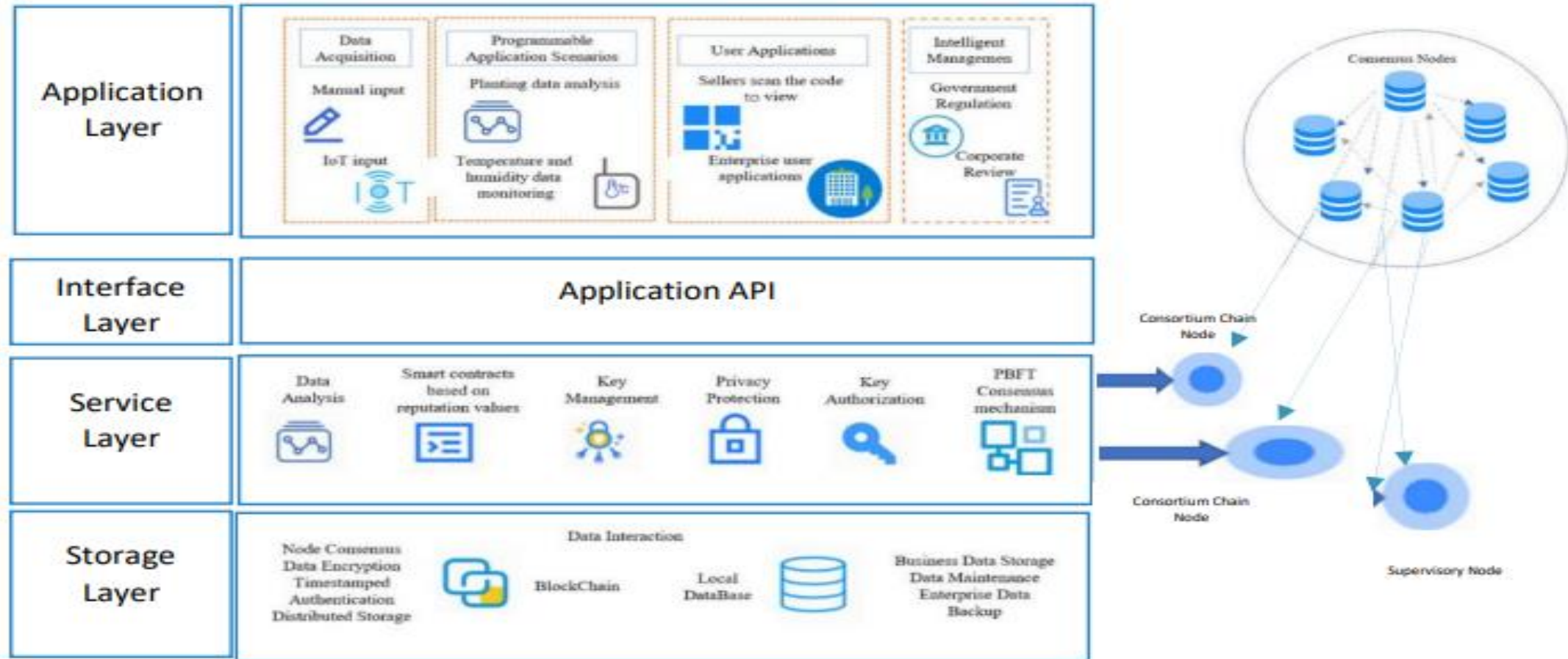


Figure 1: Blockchain Based Traceability Solution Architecture, source Grus & Grade.

End to End Traceability Architecture

Seed Company Node 1

- QR/RFID Enabled Block - Smart Contract
- Seed Company Provides detailed seed / crop composition, nutrition content, date of production, batch, size, etc.
- First node and smart contract between seed company and seed distributors (labeling and packaging ensured).
- First layer of traceability

Seed Distributors Node 2

- A smart contract between Distributors to Retailers
- Second block created through smart contract between distributor and retailers.

Retailer Node 3

- Retailers provide seed to farmers, created another smart contract in Hyper ledger Fabric
- Third block is created, user or farmer data mapped on distributed ledger

Farmer Node 4

- Farmer takes image of farm while using HP seeds
- Seed quantity supplied is recorded
- approximation of cultivated area per unit of seed is recorded
- estimated production per unit of seed cropped vs area of land needed recorded
- the data is cross talled by claim made by farmers
- Cultivated crop is tracked for growth and production using mobile, Image Processing and sensors on filed

Harvester & Transporter sub-Node

- Final Agri Commodities transported to millers through transporters
- Image mapping using Google Map and mobile image tracked
- QR code on gunny packs for traceability by millers

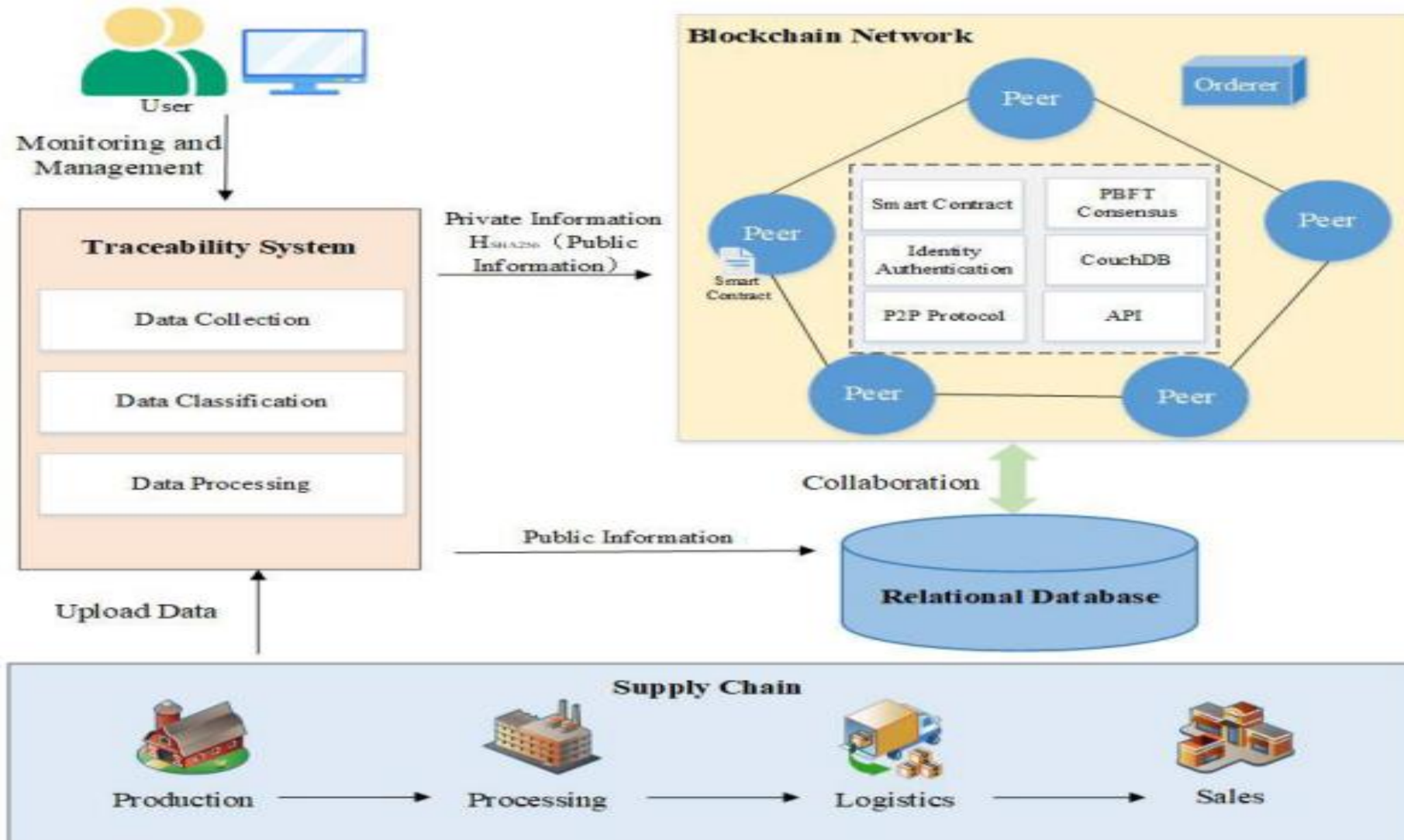
Food Processor / Miller Node 5

- Smart Contract between farmer and miller
- Millers can aggregate at better price, quantity and quality using traceability
- better price to farmers
- Prediction about supply from farmers
- Prediction of timings for procurement
- Staging for processing on real time basis

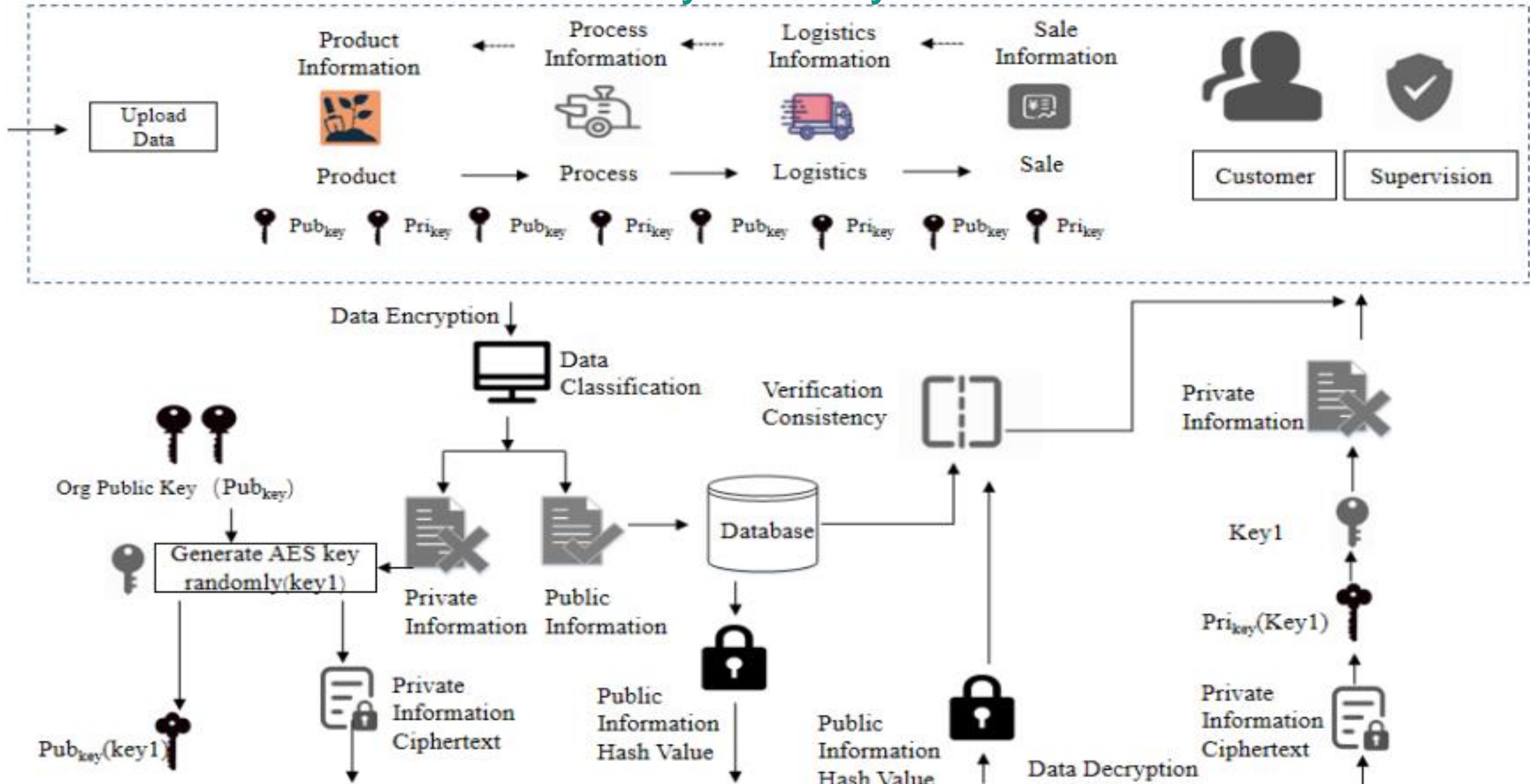
Food Company and Distribution Node 6

- Final Node and smart contract for food processors and food company
- Consumers can scan QR code to know about origin, variety, nutrition, chemicals etc.

On Chain, off Chain Data Collaboration



Traceability Privacy Protection



Smart Contract Interface

Contract Business Logic	Interface Definition	Interface Description
Upload Traceability Data	Put Trace data	Upload hash value of traceability data to blockchain
Query Traceability data	Query Trace data	Query hash value of traceability data from the blockchain
Initiate reputation value	InitReputation	Initiate reputation value when node joins alliance
Allocate reputation value	GetReputation	Grant reputation value to node
Query reputation value	QueryReputation	Query Reputation value of node.

Use of AI in Food Supply Chain Management

Today technology has progressed to the extent where AI is automating and improving many time-consuming tasks while giving Procurement Experts **additional insights** based on **complex and large sets of data**.

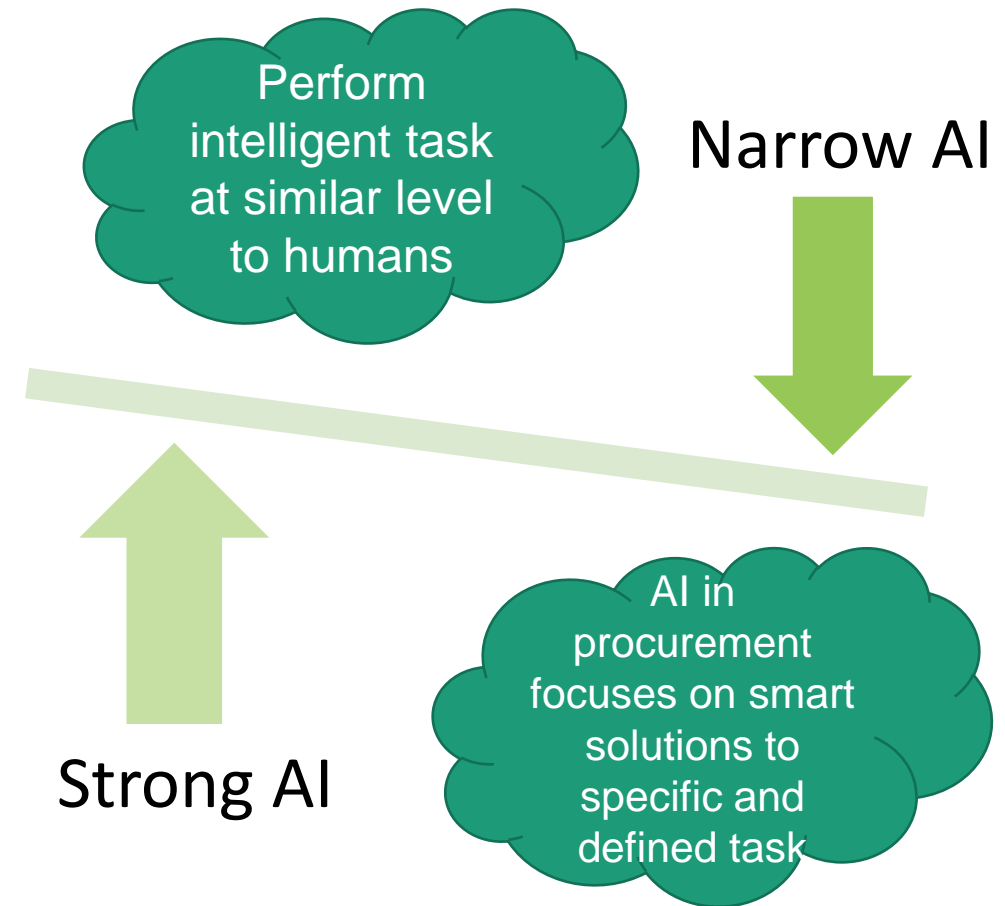
All AI solutions today in procurement will require active expert guidance and oversight.

Training AI with procurement Data

Training data → Specific Challenge → Unclassified Procurement data → Testing of output → Feedback

Case 1: AI has high confidence: It can classify data correctly; the data would be automatically categorized without human input.

Case 2: AI does not have high confidence: The classification decisions would be reviewed by Procurement experts. This process is sometimes called “human annotation.”



With feedback from human reviews, Procurement Data would be both classified and utilized to actively teach the AI algorithm to classify future data.

Over time, the confidence of the AI would improve to automatically classify more data, while also increasing the quality of data classification based on the human input.

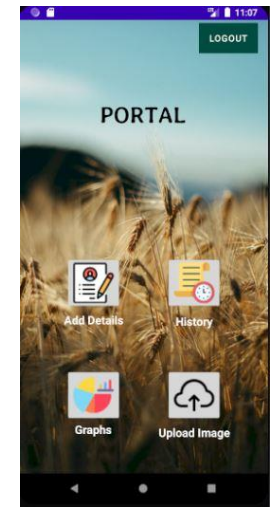
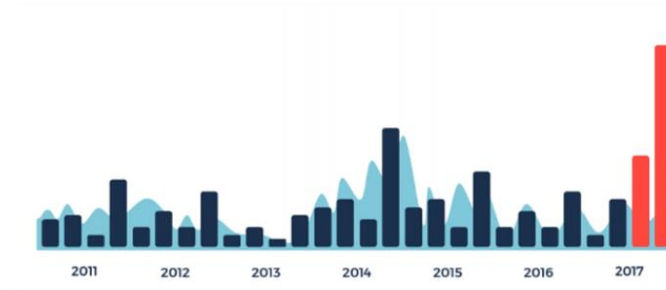
Some Insights on AI Enabled Procurement Management

- 1. Spend Classification:** Using machine learning algorithms to classify procurement spend into categories and sub-categories.
- 2. Capturing Farmers (suppliers) data:** Use techniques such as natural language processing to look for and capture data on suppliers or specific markets
- 3. Anomaly detection:** Quality Assurance Using machine learning algorithms to automatically detect and surface insights relevant to Procurement.

Transactions					
Spend	AI Suggestions	AI Confidence	Crop Variety, Quality, Quantity, Proximity	Farmer Ownership/ rented	Account / Village/ Land / Tennent

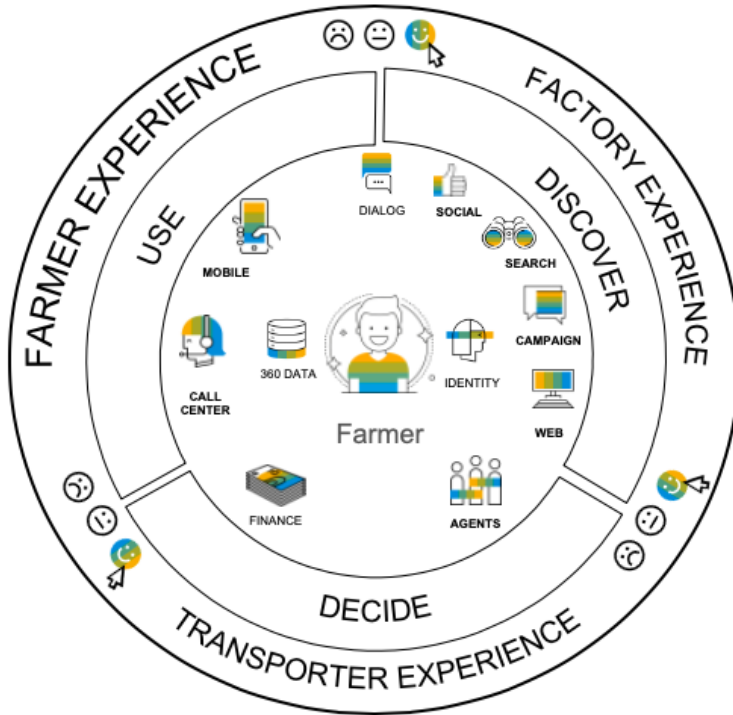


Plot No. 365



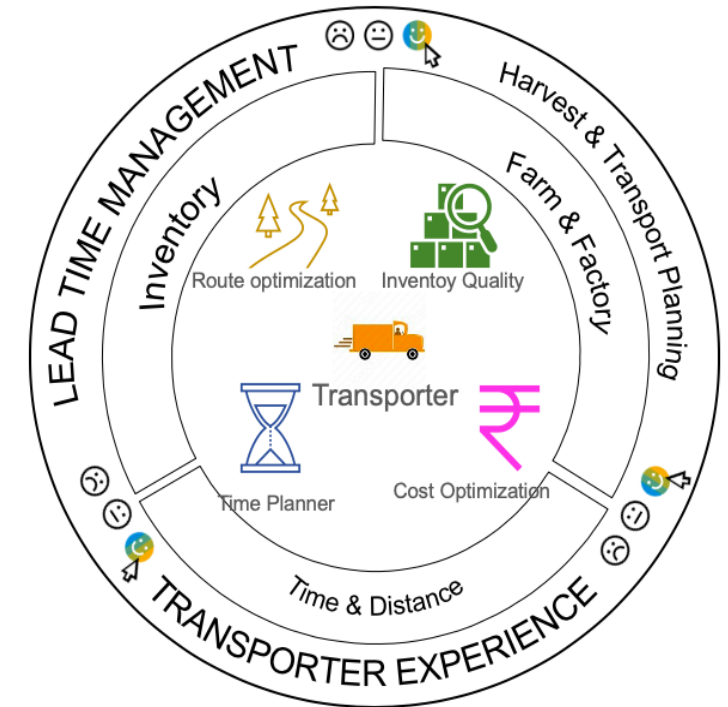
AI Enhancing Stakeholders' Experience

Farmer's Experience



Processors Experience

Transporter's Experience



AI ultimately creates a win-win solution for all the stakeholders

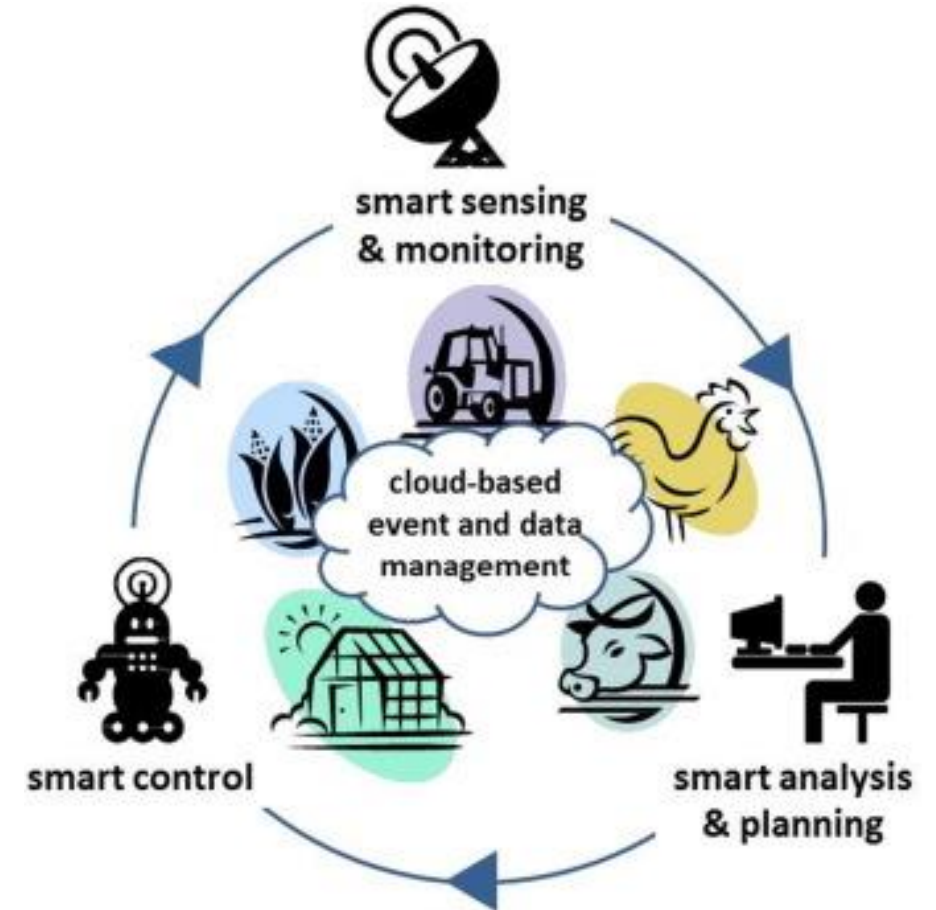
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Virtuous Circle of Value Through AI



IOT & Big Data Analytics

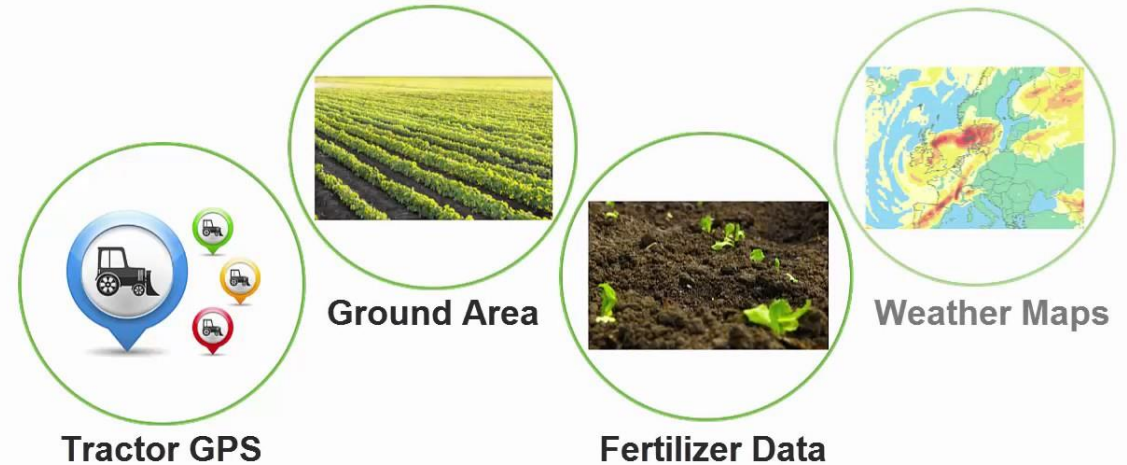
- Big Data Analytics contains collection, compilation, and timely processing of new data to help farmers and analyst make better and more informed decisions
- Farming processes are increasingly becoming data-enabled and data-driven, thanks to smart machines and sensors that generate vast amounts of farm data.
- Traditional tools are being replaced by sensor-equipped machines that can collect data from their environments to control their behavior – such as thermostats for temperature regulation or algorithms for implementing crop protection strategies.
- Technology, combined with external big data sources like weather data, market data, or standards with other farms, is contributing to the rapid development of smart farming.
- Any deviation from defined route will alert the respective stakeholders.
- During payment to transportation company, these route deviations will be calculated and accordingly billing will be adjusted.



Big Data Applications

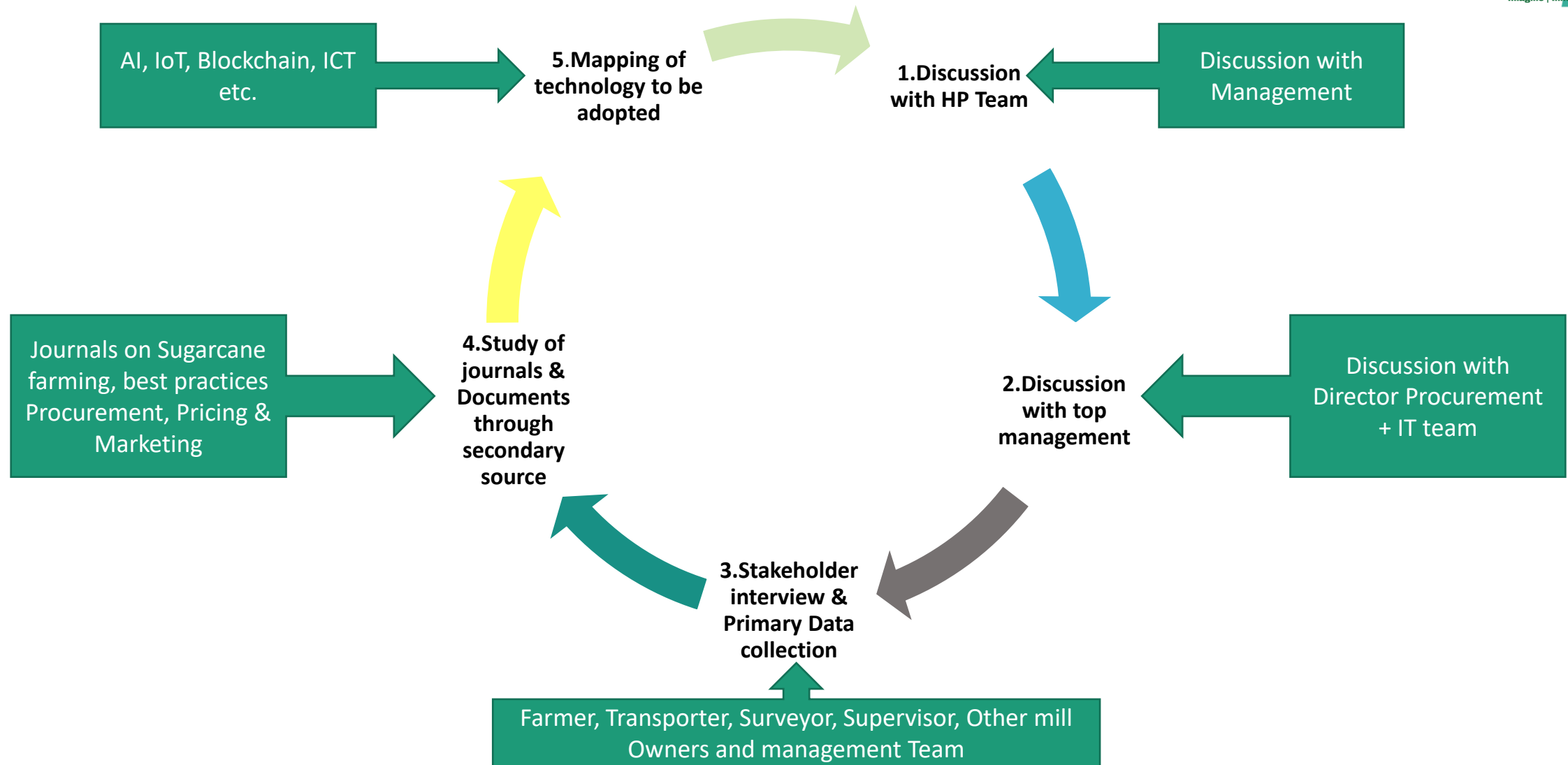
- Big Data Applications
 - Sustainability
 - Global food security,
 - Safety
 - Improved efficiency
- These global issues have extended the scope of big data beyond farming and now cover the entire food supply chain.
- With the development of the Internet of Things, various components of agriculture and the supply chain are wirelessly connected, generating data that is accessible in real-time.
- Primary sources of data include operations, transactions, and images and videos captured by sensors and robots.
- However, extracting the full potential of this data repertoire lies in efficient analytics.
- The development of applications related to risk management, sensor deployment, predictive modeling, and benchmarking, has been possible due to big data.

Maximizing Yield with Big Data





Research Methodology

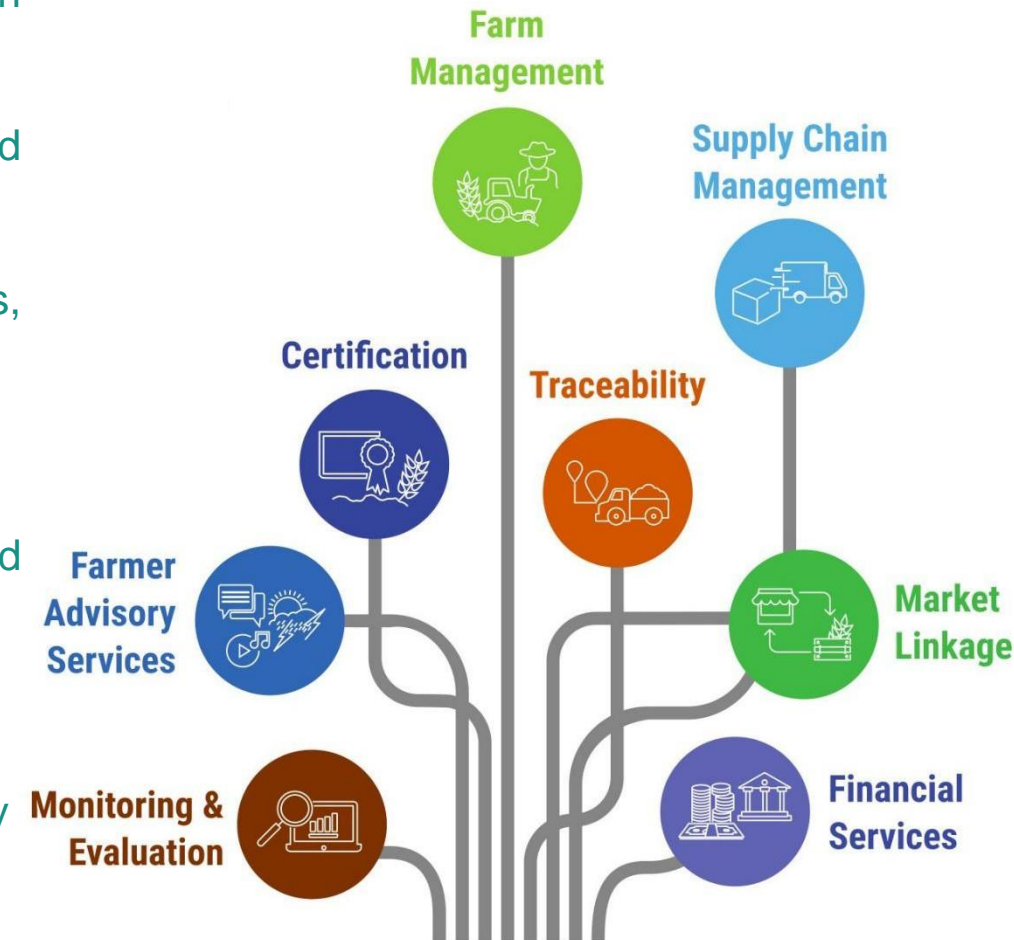


An illustration with a teal background. A white ship is on the right, with a figure using a red telescope. A large white searchlight beam originates from the ship and illuminates a large, stylized number '4' that is partially submerged. The top of the '4' is above the water line, while the rest is underwater. Inside the '4', the text 'Value Derived' is written in green. To the left of the '4', two white circles are stacked vertically. At the bottom of the '4', a diver is shown with a red flashlight, and another diver is visible further up. Bubbles are rising from the divers.

Value Derived

Desired Product Functions

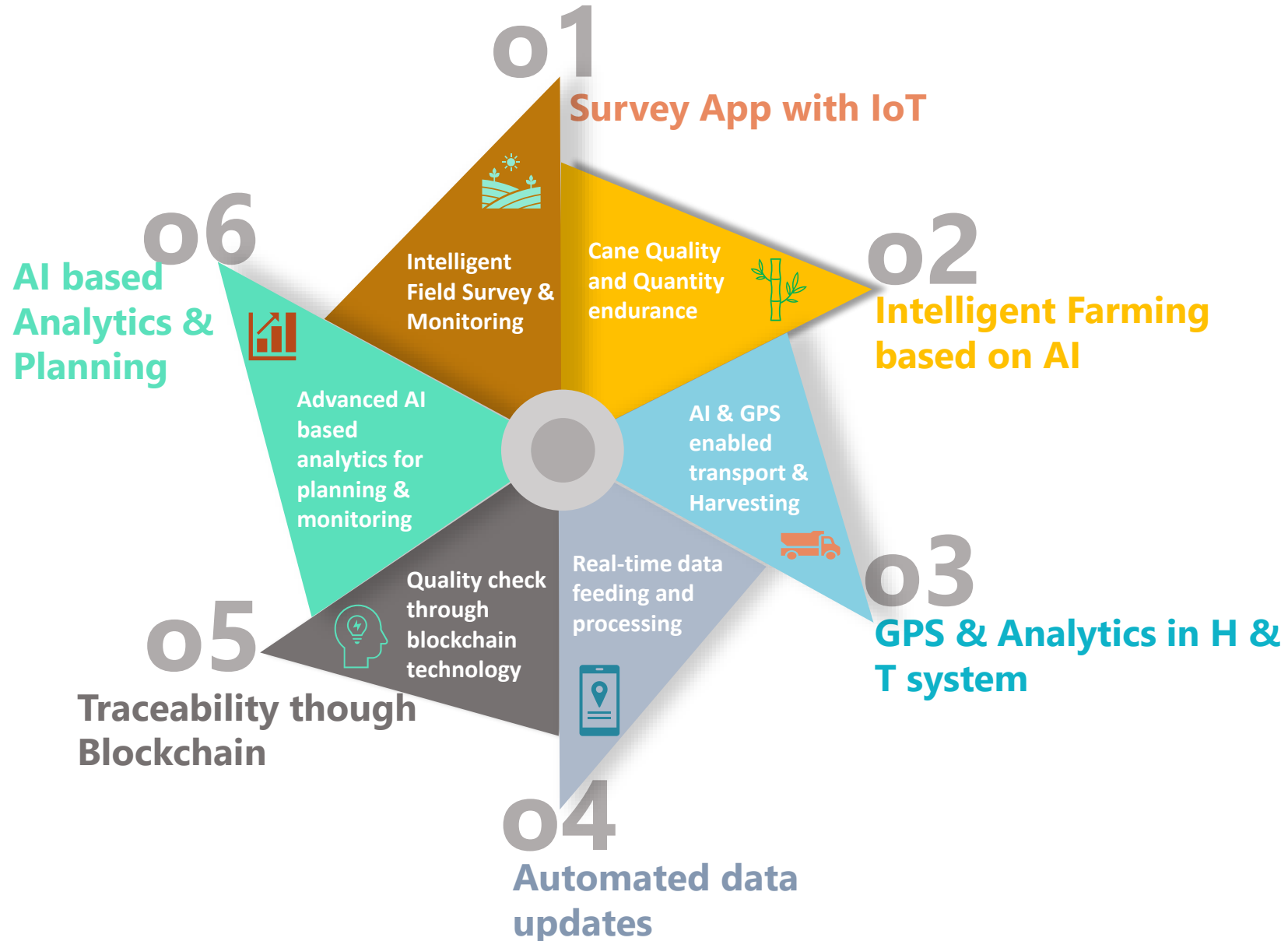
1. Real-time assessment of crop (quantity & quality) through tie-up with farmers
2. Continuous monitoring and assessment of farmers, crop, quality and quantity
3. Provide real-time feedback to farmers about soil, water, fertilizers, pesticide
4. Realtime quality assessment (pre harvest & post harvest)
5. Prevent lapses in quality, quantity (system based, people based and process-based gaps)
6. Manage & monitor gaps in transportation
7. Optimize route, real-time monitoring of post harvest crop, maintain quality
8. Real-time update of data and analytics
9. Get farmers' loyalty by continuous and planned engagement
10. Tools for advanced planning and monitoring



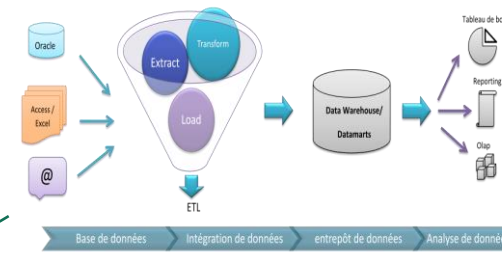
Grus & Grade's Solution Matrix



What We Offer



Surveying & Planning



Data updated on real time basis over the cloud to local server

Data can integrate with SAP applications

1. Dynamic AI based image sensory app

2. Dashboard for farmers, supervisors and top management

3. Advanced AI based analytical tools

Cloud Based Advanced application tools for real time data monitoring, management and analysis for transparent and actual survey reports.

Cloud based CRM application and back end office data management

CRM to Farmers

Real time contract between farmer and factor
Real time monitoring,, feed back to factory about farmers activity

Continuous support to farmers to improve crop yield, post harvest planning and activities

Real time update to factory and farmers about billing, payment, bank details etc.

Farmer

CRM to Farmers

Real time analytics for better decision and planning.

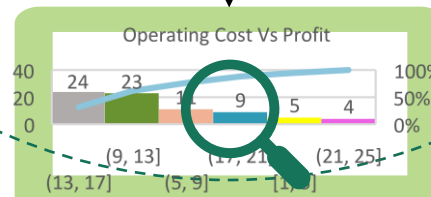
Different dashboard for farmers, field supervisors, surveyors, management

AI & Blockchain

Cloud based integrated data warehouse with advanced analytical tools and real time data processing, assimilation, transmission and monitoring

Field Staff

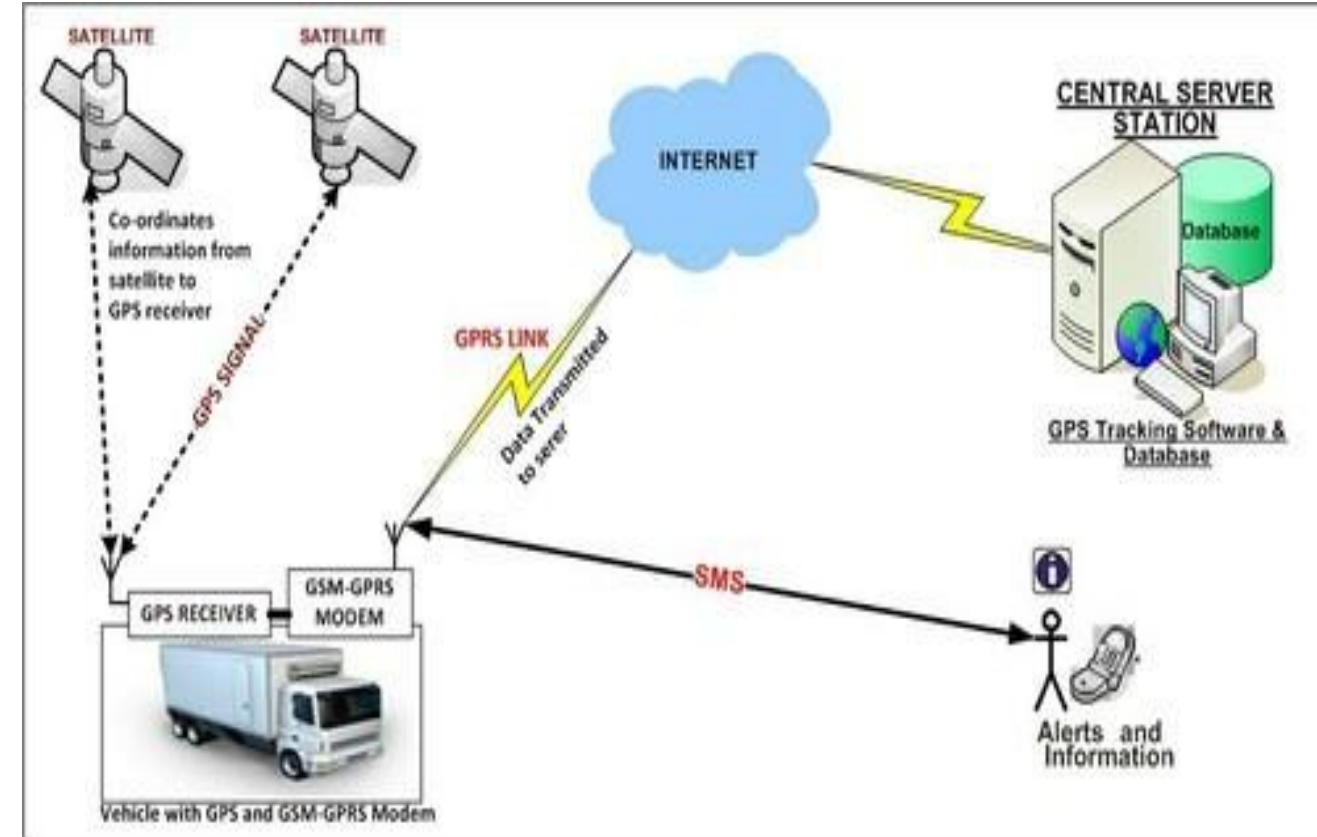
App to farmer as well supervisor with data giving a relative feedback to factory for continuous monitoring and planning



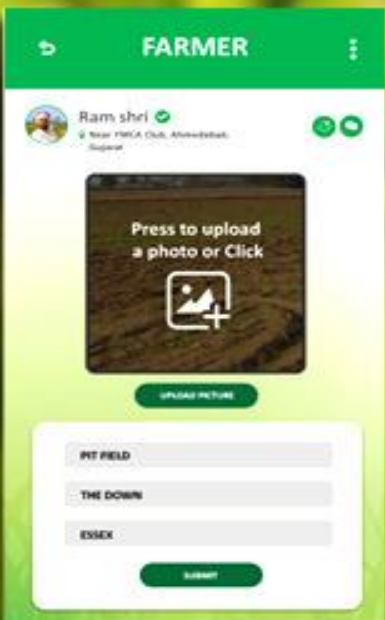
Growth in Profit

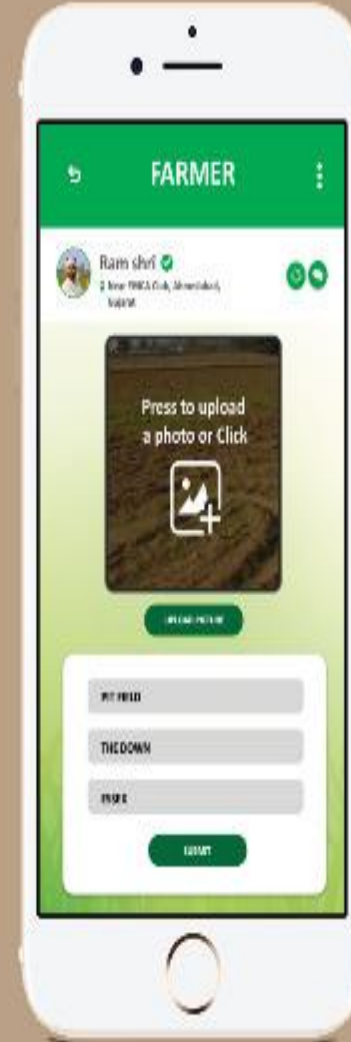
Transport Management Solution

- System suggested, predefined route mapping leading to optimized H&T
- Vehicle system monitoring system will be installed in Central Server Station/ Cloud Server
- GPS Receiver will be installed in all transportation vehicles along with GSM-GPRS modem¹
- Transportation movement will be monitored continuously by the installed system.
- Any deviation from defined route will alert the respective stakeholders.
- During payment to transportation company, these route deviations will be calculated and accordingly billing will be adjusted.



¹Client views solicited on feasibility of installing GPS tracker on transportation vehicles





Farmer Interface & Services



Data to be captured:

- Farmers name, village
- Land, Survey no, irrigation type
- Type of soil, water, crop, fertilizer
- Distance, Rented farm,
- Avg. yield, variety,
- Banking details

Value for client

- Increase farmer engagement, hence improved scope of procurement plan being complied
- Automatically plan procurement pricing based on sugar content of each farm (variable pricing)
- Minimize Human Intervention in long run.

Key Attributes

- Easy to use app by farmers.
- User friendly interface
- Updated data loading tools
- Features to automatically update database

Functions/Applications for farmers

- Weather forecasts
- Alerts for approaching irrigation requirement and/or for putting fertilizer
- Pest threat alert, pre harvest cost, Cultivation and harvesting time monitoring
- Time to harvesting countdown
- Harvesting and transportation scheduling
- Automatic update of sugar content and total quantity harvested as available **at the factory gate.**
- Value of produce as per prevailing FRP
- Probable date of payment receipt¹

¹Optional feature, to be added as per client's instructions

Supervisor Interface & Services



Data to be captured:

- Farmer details, Village, Land
- Sowing Date, Periodic Growth
- Soil, Weather, Water, Fertilizer, Pesticide, Support
- Periodic Quality, Farmer Tie up
- Harvesting Date, Time, Quantity, Quality,
- Periodic Survey, Harvesting Pattern

Value for client

- Task scheduler for field staff to ensure regular farmer visits
- Real time periodic data for monitoring, support and realization of proceeds
- Farmer connect, loyalty
- Quality and quantity improvement

Key Attributes

- Easy to use app by field staff
- User friendly interface
- Simple data loading tools
- Features to automatically update database
- Image processing, QR for quality

Functions/Applications for Supervisors

- Alerts for diversion of crop to other factory
- Advisory alert for farmers inputs, pests, water, soil etc.
- Auto alert and tie up with harvesters
- Quality assurance monitoring, transporter tip up and follow up
- Scheduling of harvesting and transporters, helps in RR improvement by reducing lead time.

Owner Interface & Services



Data to be captured:

- Demand from Market
- Vendor details
- Pricing Details
- Quantity and Quality procured
- Budget provision , Expenditure pattern

Value for client

- Real time data access from anywhere, anytime
- Process efficiency, increased in RR, reduction in overall operating cost
- Minimize Human Intervention in long run.
- Real time monitoring, feed back to factory about farmers activity

Key Attributes

- Easy to understand dashboard.
- Analytics with real time data,
- Anywhere anytime access
- Alerts and feedback for planning, monitoring and execution
- Features to automatically update database

Functions/Applications for farmers

- Operational cost analytics, Budgetary support
- Automated recovery rate, Quality assessment
- Lead time monitoring and follow up
- Automated alerts and back up
- Analytics, Planning, Scheduling and monitoring in single dashboard.
- Value of produce as per prevailing FRP
- Catchment area monitoring

Transporter Interface & Services



Data to be captured:

- Vehicle type, Model, Fuel efficiency, Chassis, Owner, Driver
- Harvesting Schedule, date-time planner
- Route map, Distance Tracking

Value for client

GPS Tracker, Planner for transporters
Planner for harvesters
Reduction of lead time, cost

Advanced AI based analytics tools for data management, analysis, reporting on the go

Key Attributes

- Easy to use app by farmers.
- User friendly interface
- Updated data loading tools
- Features to automatically update database

Functions/Applications for Transporter

- Transport and logistics route mapping
- Harvesting Schedule planning
- WIP at factory gate, WIP at field – Inventory planning – Reduce lead time
- Fuel Efficiency, route tracking & support
- Harvesting and transportation scheduling
- QR | Blockchain based paper clearances at factory gate – reduce delivery and lead time
- **People planning, process and placement**
- Probable date of payment receipt

What We Offer

Analysis and Reporting

Advanced AI based analytics tools for data management, analysis, reporting on the go

Application with advanced features of image sensing

User friendly report dashboard

Ease to use supplication by management, employee, farmer, transporter etc.



Real-time quality check

Image sensory based monitoring of standing crop

Data reporting for advanced planning, reporting and analysis

Reduction of human interface

USE of CRM for notification and updates to farmers

Automatic update to management

Automatic update to field officials, factory officials etc

Auto update of harvester, transporters

Report and analysis based on advanced analytics

Saves cost, improves efficiency

Advanced planning, monitoring and support

Applications

Easy to use, understand and implement

Automated reports, dashboard

Real time update of feedstock quantity, quality and gaps

Farmer support and loyalty



Adding Value

Value delivered by the solution: Values

Value 1

Functional benefit: Increased transparency & Traceability

Realized Benefit 1: Increase in yield

Value delivered: Topline growth in INR

Realized Benefit 2: Better value for purchase for the factory → payment as per yield

Value delivered: Reduction in raw material cost

Total value delivered (1) = Topline growth in INR + Reduction in raw material cost

Value 2

Functional benefit: Better farmer connect

Realized Benefit: Improved line of sight for incoming raw material → better capacity utilization

Value delivered: Reduced operational expenses (1)

Total value delivered (2) = Reduced operational expenses (1)

Value 3

Functional benefit: H&T Scheduling → better planning

Realized Benefit 1: Reduced waiting time at the factory gate

Value delivered: reduced operational expenses (2)

Realized Benefit 2: Improved visibility of incoming raw material

Value delivered: Reduced operational expenses (3)

Net value delivered = Reduced operational expenses (2) + Reduced operational expenses (3)

Value Delivery with Improvement in Efficiency

FIG 1. DAYS OF FACTORY RUN VS PROFIT GROWTH %

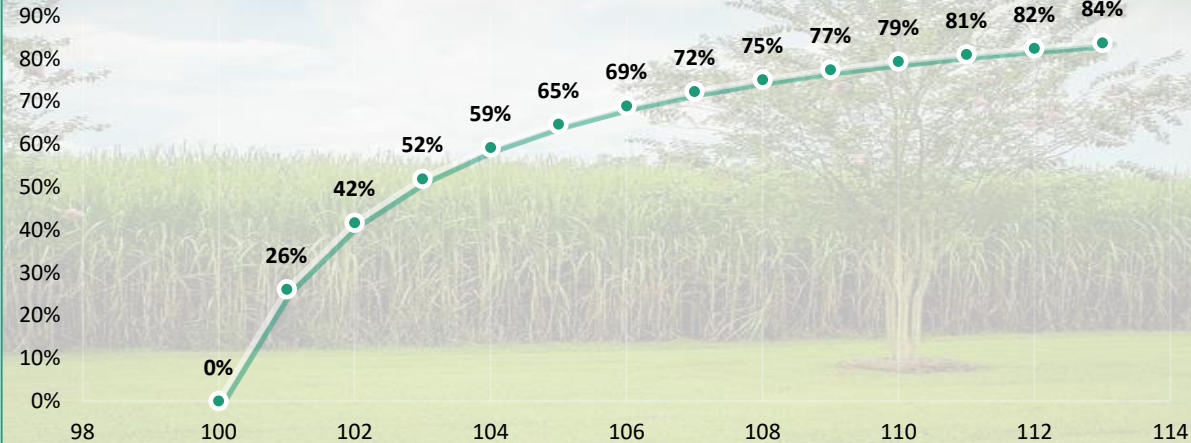
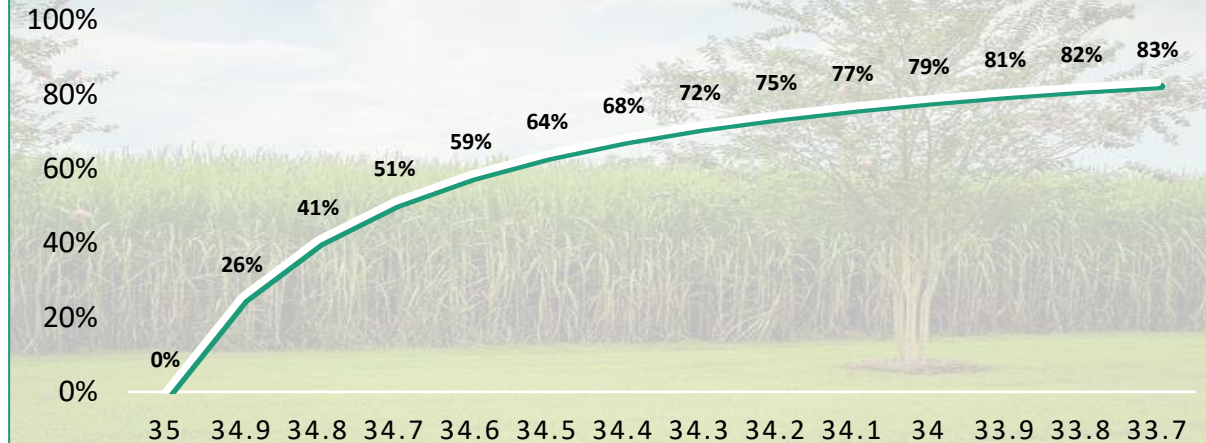


FIG 2. REDUCTION IN H&T COST VS PROFIT GROWTH %



Objective Function for Profit:

$$Y = 0.0523x + 0.2195, R^2 = 0.8048$$

For every case in these 3 figures, profit growth % is calculated for each unit increase in the respective control variable. Hence, the profit growth % is the only in case that variable is enhanced, while rest all variables remain constant

FIG 3. RECOVERY RATE VS PROFIT GROWTH %



Next chart shows cumulative profit % growth

Scope of Work

Phase 1 : Automation Tool with Analytics

S No	Scope	Details
1	Base Automation Tool using Blockchain	<ul style="list-style-type: none"> Survey Details Module Farmer Module: Registration, Farm Distribution Management, Crop Area Mapping, Cultivation Details Miller/ Processor Registration Contract Details Seed Procurement and distribution (end to end)
2	Mobile App enabled with blockchain	App for Farmers/ Millers <ul style="list-style-type: none"> Update registration/ cultivation data from field Receive real time updates to manage/ monitor crops
3	Crop Planting Analytics	Automated suggestions by tool for Crop categories specific to Field/ environment based on survey details and prior data analysis
4	Pre-Harvesting Cost Analytics	System generated cost reports based on multiple parameters available in the database
5	Crop Quality Assessment	Image Processing - Based on Pictures shared from field by Farmers/ Supervisors
6	Crop Availability Assurance	Image Processing - Based on Pictures shared from field by Farmers/ Supervisors
7	Notifications	<ul style="list-style-type: none"> Automated Notifications on regular intervals to farmers for Crop management. Notifications to provide regular updates of Crop Availability / Image sharing

.....continued on next chart

Scope of Work

Phase 1 : Automation Tool with Analytics

S No	Scope	Details
8	Transportation - Route Planning & Monitoring	<ul style="list-style-type: none">• Route Map definition, Best Route identification• Alert on taking non specified routes• Update to Billing module on wrong routes to adjust corresponding billing
9	Post Harvesting Cost Analytics	System generated cost reports based on multiple parameters available in the database - Harvesting/ Cultivation details, Transportation details etc
10	Billing Module	Billing for Farmers/ Transportation Company
11	Analytical Reports	Reports providing details on Phase wise process, cost, improvement and optimization suggestions
12	Management Dashboard	System view providing information (Cost/ Effort/ Timeline) across every Phase with Analytical Widgets and Graphical Views
13	ROI Reports	Multiple ROI Reports providing in-depth cost analytics of the entire Automation process
14	Data Security	Enhanced security based on Blockchain Technology
15	Third Party Integration Capabilities	API Interface creation to connect with and export/ import data with Third Party (SAP etc)

Scope of Work

Phase 2 : Advanced AI / Analytics/ IOT Implementation

S. No	Scope	Details	Prerequisites
1	Image Processing	Advanced AI implementation to analyse data collected from phase 1 roll out to Phase 2 commencement	Substantial adaptation in phase 1 to ensure enough and regular data capturing
2	Big Data Analytics	<ul style="list-style-type: none">Analytics on the data derived from image processing to increase strength of predictive insights delivered by the systemField information dependent only the images captured in the farmer dashboard – field staff can be diverted to some other job → process starts becoming people agnostic	
3	IOT	<ul style="list-style-type: none">Usage of sensors and processors in the field to increase accuracy and predictive strength of the AI engine	

- Phase 2 is essentially the phase of scaling up capabilities of the AI engine and building predictive strength in the system
- Remains a separate project depending on client's wish
- Phase 1 is a complete solution in itself with very strong predictive capabilities which will keep increasing as the system gains experience

Sampling Strategy and Sample Size

- For the pilot project Part A (Millet Cultivating States of Rajasthan, Karnataka and Maharashtra)

Stakeholder	Crop	State	Sample Size
Farmer (Mix of Large farm holders + Small Farm Holders): Based on willingness to be part of research for one year	Iron Pearl Millet	Rajasthan, Karnataka, Maharashtra	300
-do-	Zinc Wheat	Bihar, U.P., Punjab	600
Millers			30
Food Processor – Distributor			2
Seed Company			2
Seed Distributor, retailer			10

Part Number	HSN Code	Description	Quantity	Unit Price	Total (USD)
SOFTWARE DEVELOPMENT					
GG_SW	Automation Tool	Base Module for Automation Tool AI/ Analytical suggestions Transportation - Route Planning & Monitoring Cost Analytics - Optimization/ Suggestions/ Improvements Data security - Blockchain Technology + Image Processing, GEO Tagging, Crop Monitoring	1	22,600	22,600
GG_MA	Mobile APP	App for Farmers/ Supervisors * Update registration/ cultivation data from field * Receive real time updates to manage/ monitor crops	1	7,900	7,900
A. Software Cost			Sub Total		30,500

SERVICES + Implementation					
GG_DP	Solution Deployment/ Stabilization	Around 15 Months for Deployment.	1	15,000	15,000
GG_SV	Services Team	Team of Engineers at Onsite/ Offsite for various services such as Cloud Infra/ Cloud Services Mgmt Vehicle - GSM devices Mgmt Automation tool/ Mobile App Mgmt Database Management Client Interaction - Farmers/ Surveyor/ Third party (Transportation vendors etc) Reports Generation	1	10,000	10,000
B. Services Cost			Sub Total		25,000

INFRASTRUCTURE					
GG_IF		Cloud Servers / Cloud Services	1	1500	1500
C. Infrastructure Cost			Sub Total		26,500

HARDWARE					
GG_HW	GPS - GSM Modem (Route Tracker)		10	300	3000
D. Hardware Cost			Sub Total		29,500

TRAINING					
GG_TR	Training for all stakeholders	3 Months training for all stakeholders (Millers/ Food Processors/Seed co/ Farmers etc)	6	1,500	9,000
E. Training Cost			Sub Total		9,000

Total Solution Cost with 1st year AMC = A + B + C + D + E					USD 69,000
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+ GST @ 18%

Timelines

