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Model Design Management Information System Of Agricultural Businesses In Areas With Limited Internet Access

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Abstract: This study examines the management information system (SIM) development model. Case studies were conducted in several villages or areas with limited internet access in Gowa Regency, South Sulawesi using a customized ADDIE (Analysis, Design, Development, Implementation and Evaluation) model research and development method. Data were collected through in-depth interviews, observations, focus group discussions, and document analysis of stakeholders. The results of the study show the stages that must be carried out in the development of management information systems. This stage includes procedures and technical matters that must be carried out in the process of system development, especially agricultural businesses located in remote areas or rural areas with limited internet access.

Keywords: Agricultural Business; Entrepreneurship; Limited Internet Access; Management Information System.

A. Introduction

The agricultural sector has a strategic role in national economic development. Especially in the era of the President of the Republic of Indonesia, Prabowo Subianto, who placed the agricultural sector as his main target (detikpertanian.id, 2024) One of the targets in this sector is the establishment of a food brigade to cultivate 200 hectares of land and provide grants for mechanization equipment, seeds, fertilizers, and assistance with a total budget of IDR 3 billion per brigade (Pilarpertanian, 2024) Of course, this needs support from all other aspects.

On the other hand, entrepreneurship needs to take a role in the food brigade to be more optimal, because it can:

1. Help increase productivity by developing more efficient innovations and technologies.
2. Helping food brigades develop more effective and efficient business models, so as to increase the income and welfare of brigade members.
3. Helping food brigades improve product quality by developing higher quality standards and implementing more advanced technologies.

Meanwhile, in the current era of digital disruption, information technology takes on the role of a catalyst due to:

1. Helping food brigades manage data on production, income, and welfare of brigade members.
2. Helping food brigades optimize production and distribution processes by using more efficient information systems.
3. Assist food brigades in improving access to markets by using digital platforms to promote products and contact buyers.

The use of information technology in food brigades includes (Agunawan et al., 2021):

1. Management Information System (SIM): Food brigades can use SIM cards to manage data on the production, income, and welfare of brigade members.
2. Mobile Apps: Food brigades can use mobile apps to promote products, contact buyers, and manage production and distribution processes.
3. Digital Platforms: Food brigades can use digital platforms to promote products, contact buyers, and manage production and distribution processes.

Thus, the role of entrepreneurship and information technology in the formation of food brigades is very important and strategic to improve productivity, product quality, and access to markets.

The management of agricultural businesses in Indonesia still faces various challenges, especially in terms of effective management and decision-making (Ahmad et al., 2021). In this era of digitalization, the use of information technology is a fundamental need to increase the efficiency and productivity of the agricultural sector. Some of the problems that are often faced in the management of agricultural businesses in rural areas include:

1. Recording and documentation are still manual, causing difficulties in tracking and analyzing data.
2. Limited access to information related to commodity prices, weather, and the latest agricultural technology.
3. Difficulties in integrating various aspects of management such as finance, inventory, production, and marketing.
4. Decision-making is not optimal because it is not supported by accurate and real-time data.
5. Limitations in monitoring and evaluating agricultural business performance.

The Management Information System (SIM) can be a solution to overcome this problem. SIM enables integrated data and information management, supports data-driven decision-making, and improves the operational efficiency of agricultural businesses (Abrantes & Figueiredo, 2021; Sentosa et al., 2023).

This research is intended for the needs of agricultural business management. The system developed is expected to help farmers and agricultural business actors in:

1. Manage production data and inventory.
2. Optimizing planting and harvesting planning.
3. Monitor financial condition and cash flow.
4. Access market information and commodity prices.
5. Create reports and analyze business performance.

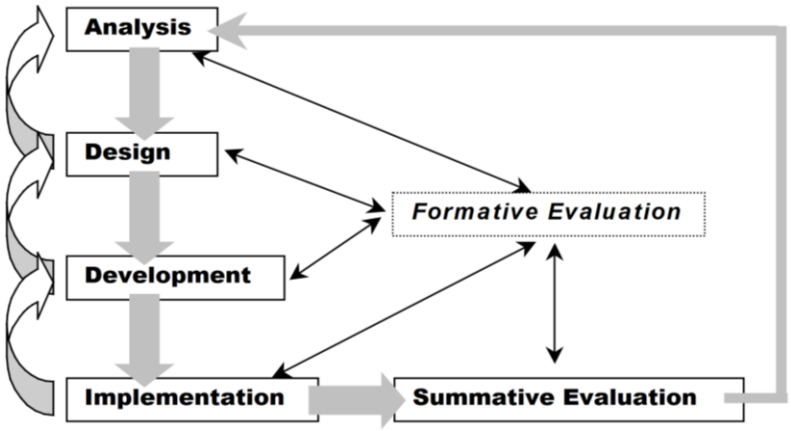
The challenge in the implementation of driver's licenses for agricultural businesses is that agricultural locations are generally in rural and remote areas with limited internet access (Shafique et al., 2020).

Based on this, this study aims to create a management information system model for agricultural businesses in the region to overcome the limitations of internet access by focusing on the following aspects:

1. The system is designed with local storage capabilities (offline-first approach).
2. Data can be inputted and accessed without an internet connection.
3. Automatic synchronization when a connection is available.
4. Uses Progressive Web App (PWA) technology for offline access.

B. Materials and Method

The research methodology used is Research and Development (R&D) by adopting the ADDIE (Analysis, Design, Development, Implementation and Evaluation) model which is tailored to the needs (Agunawan & Rijal, 2024; Dr. Budiyono Saputro, M.Pd., 2017)



Gambar 1. Cycle ADDIE Model (Branch, 2009)

The stage of needs analysis to identify problems or gaps that need to be addressed. This analysis involves: (1) identification of problems or gaps, (2) analysis of user needs, (3) analysis of available technologies and resources.

The design stage is the second stage in the ADDIE model. At this stage, the researcher designs the product or system to be developed. This design can involve designing: (1) the system architecture, (2) the user interface, and (3) processes and workflows.

The development stage is when the researcher develops a product or system that has been designed. This development can involve the development of: (1) software, (2) hardware, and (3) content and materials.

The implementation stage is when the researcher implements the product or system that has been developed. This implementation may involve: (1) system testing and validation, (2) user training and mentoring, and (3) system setup and configuration.

The evaluation stage is the final stage in the ADDIE model. At this stage, the researcher evaluates the product or system that has been implemented. This evaluation can involve: (1) measuring the performance of a product or system, (2) collecting feedback from users, and (3) analyzing and interpreting the results of the evaluation (Agunawan, 2020; Makmur & Agunawan, 2021)

Every time you complete one stage, there is a formative evaluation that if a discrepancy is found, you can return to the previous stage, until a conformity is obtained.

C. Results and Discussion

The results of this research are as follows:

Stage of Analysis

a. User Needs Analysis:
   1) Farmer:
      a) Farmers' technological literacy level
      b) Current farming business registration habits
      c) Types of information that are often needed
      d) Devices used

e) Obstacles faced in business management
f) Expectations for the system to be created.

2) Maintainer:
a) Monitoring process carried out
b) Data to collect
c) Required reporting format
d) Data collection frequency
e) How decision-making is made

b. Analysis of Internet Infrastructure and Limitations:
1) Mapping of signal strength in the target area.
2) Identify the available providers.
3) The times when internet access is available.
4) Average bandwidth when internet is available.
5) Stability of the power grid.
6) Availability of supporting devices.
7) Internet access fee.

c. Business Process Analysis:
1) Farming workflow from upstream to downstream
2) Financial records carried out
3) Stock and inventory management
4) Planting planning process
5) Recording of crop yields
6) Marketing system used
7) Cooperation with others
8) Decision-making process.

d. Technology Analysis:
1) Identify technologies suitable for offline conditions
2) Appropriate development platform
3) Data storage needs
4) Possible backup mechanism
5) Offline data security
6) Efficient synchronization technology
7) On-premises/cloud server needs
8) Compatibility with user devices

e. Identify Problems and Obstacles:
1) Manual logging issues
2) Data communication constraints
3) Monitoring difficulties
4) Risk of data loss
5) Human resource limitations
6) Cost constraints
7) Data security issues
8) Cultural/customary constraints

f. Documentation of Analysis Results:
1) Creation of system requirements documents
2) Preparation of development priorities
3) Estimate of resources needed
4) Risk analysis
5) Technical solution recommendations
6) Development timeline
7) Cost estimate
8) Success indicators

The data collection methods for this analysis are:

a. Interviews with stakeholders
b. Field observation
c. Existing system documentation studies
d. Focus Group Discussion (FGD)
e. User surveys
f. Analysis of similar systems
g. Consult an expert

While the output produced from this stage is in the form of:

a. System Requirements Specification Document
b. Map of Existing Conditions
c. List of Functional and Non-Functional Needs
d. Gap Analysis
e. Solution Recommendations
f. Development Plan

Stage of Design

a. System Architecture Design
1) Application architecture:
a) Selection of architectural patterns (e.g. client-server, standalone, hybrid)
b) System component structure
c) Communication mechanism between components
d) Data architecture
e) Application layer/tier
f) System security

2) Technical infrastructure:

a) Minimum hardware specifications
b) Supporting software needs
c) Network configuration
d) Storage needs
e) Backup system

b. Offline-First Database Desain
1) Database structure:
a) Database schema design
b) Data normalization
c) Relationships between tables
d) Indexing strategy
e) Data versioning
f) Mechanism conflict resolution
2) Data Management:
a) Local storage strategy
b) Data sync priority
c) Format data
d) Data compression
e) Data retention policy
f) Recovery mechanism

c. User Interface Design
1) UI/UX design:
a) Wireframe each page
b) Layout responsive
c) System navigation
d) Input form design
e) Report view
f) Accessibility design
2) User interaction:
a) User flow
b) Feedback mechanism
c) Error handling
d) Loading states
e) Offline indicators
f) Help system

d. Synchronization Mechanism Design
1) Strategi sinkronisasi:
a) Synchronization algorithm
b) Priority queue
c) Conflict resolution
d) Delta sync
e) Background sync
f) Error recovery
2) Connection management:
a) Detection mechanism
b) Auto-retry system
c) Queue management
d) Bandwidth optimization
e) Data compression
f) Progress tracking

e. Diagramming and Documentation
1) System diagram:
a) Use Case Diagram
b) Class Diagram
c) Sequence Diagram
d) Activity Diagram
e) Entity Relationship Diagram
f) Deployment Diagram
g) Component Diagram
h) State Diagram
2) Technical documentation:
a) Specification API
b) Data dictionary
c) Security design
d) Network topology
e) System requirements
f) Integration points

f. Designing Priority Features
1) Offline features:
a) Input data
b) Searching
c) Reporting
d) Data validation
e) Local processing
f) Export/import
2) Online features:
a) Synchronizes
b) Backup
c) Update system
d) Sharing data
e) Collaborative features
f) Remote monitoring

g. Security Design
1) Security Framework:
a) Authentication system
b) Authorization levels
c) Data encryption
d) Access control
e) Audit trail
f) Privacy protection
2) Data Protection:
a) Local storage security
b) Transfer security

c) Backup security
d) Delete mechanism
e) Data masking
f) Recovery procedure

h. Testing Desain
1) Planning Test:
a) Unit test design
b) Integration test scenarios
c) System test cases
d) User acceptance criteria
e) Performance test parameters
f) Security test approach
2) Quality Assurance:
a) Code review guidelines
b) Testing methodology
c) Quality metrics
d) Acceptance criteria
e) Performance benchmarks
f) Security standards

The output of this design stage is in the form of:

a. System Design Document
b. Prototype UI/UX
c. Database Schema
d. API Documentation
e. System Architecture Blueprint
f. Security Design Document
g. Test Plan Document
h. Technical Specification

The resulting deliverables are in the form of:

a. Wireframe and mockup
b. System diagram
c. Technical Specification Documents
d. Prototype system
e. Database design
f. API Documentation
g. Test plan
h. Design documentation

Stage of Development

a. Database Development
1) Implementation database:
a) Creation of database structures by design
b) Indexing configuration
c) Setup backup mechanism
d) Implementation triggers and stored procedures
e) Setting constraints and validation
f) Query optimization
2) Data management:
a) Seed data creation
b) Data migration from legacy systems (if any)
c) System Versioning
d) Trail audit mechanism
e) Setup backup and restore
f) Caching implementation

b. App Creation
1) Development Frontend:
a) UI implementation by design
b) Development input form
c) Validation client-side
d) Implementation responsive design
e) Frontend performance optimization
f) Implementation offline storage
g) State management
2) Development Backend:
a) Deploying API endpoints
b) Business logic implementation
c) Data processing
d) Authentication & authorization
e) Error handling
f) Logging system
g) Background jobs

c. Offline Fitur Implementation
1) Local storage:
a) Setup IndexedDB/SQLite
b) Implement cache
c) Data persistence
d) State management offline
e) File handling local
f) Queue system
2) Offline Features:
a) Offline data entry
b) Local validation
c) Offline search
d) Local reporting
e) Data export/import
f) Error handling offline

d. Development of Synchronization Mechanism
    1) Sync Engine:
        a) Synchronization algorithm
        b) Conflict resolution
        c) Data merkle trees
        d) Change tracking
        e) Version control
        f) Delta updates
    2) Network Handling:
        a) Connection detection
        b) Retry mechanism
        c) Queue prioritization
        d) Bandwidth management
        e) Progress tracking
        f) Error recovery
e. Phased Testing
    1) Unit Testing:
        a) Test individual components
        b) Integration tests
        c) API testing
        d) Database testing
        e) Security testing
        f) Performance testing
    2) Quality Assurance:
        a) Code review
        b) Bug tracking
        c) Performance optimization
        d) Security audit
        e) Load testing
        f) User acceptance testing
f. Development Documentation
    1) Technical Documentation:
        a) API documentation
        b) Database schema
        c) Code documentation
        d) Deployment guide
        e) Configuration guide
        f) Troubleshooting guide
    2) User Documentation:
        a) User manual
        b) Installation guide
        c) Training materials
        d) FAQ document
        e) Quick start guide
        f) Video tutorials
g. Security Implementation
    1) Security Implementation:
        a) Data encryption
        b) Secure authentication
        c) Role-based access control
        d) Input sanitization
        e) XSS prevention
        f) SQL injection prevention
    2) Data Protection:
        a) Backup implementation
        b) Data encryption at rest
        c) Secure data transfer
        d) Access logging
        e) Security monitoring
        f) Vulnerability scanning
h. Performance Optimization
    1) Application Optimization:
        a) Code optimization
        b) Database query optimization
        c) Caching implementation
        d) Memory management
        e) Resource utilization
        f) Load balancing
    2) Mobile Optimization:
        a) Bandwidth usage
        b) Battery consumption
        c) Storage efficiency
        d) Offline performance
        e) Background sync
        f) Push notifications
i. Version Control and Deployment
    1) Version Control:
        a) Git repository setup
        b) Branching strategy
        c) Code review process
        d) Version tagging
        e) Change documentation
        f) Merge procedures
    2) Deployment Setup:
        a) Deployment automation
        b) Environment configuration
        c) Server setup
        d) Monitoring tools
        e) Backup systems
        f) Rollback procedures

The output of this stage of Development is in the form of:

a. Working apps

b. Documentation
c. Testing results

Stage of Implementation

a. System Installation
    1) Infrastructure Preparation:
        a) Server setup (if required)
        b) Database configuration
        c) Installation of supporting software
        d) Network configuration
        e) Setup backup system
        f) Basic security settings
    2) Application Deployment:
        a) Installation of applications on the server
        b) Environment configuration
        c) Setup domain/subdomain
        d) SSL/TLS Settings
        e) Firewall configuration
        f) Connection testing
b. User Training
    1) Training Preparation:
        a) Preparation of training modules
        b) Scheduling
        c) Material preparation
        d) Setup training environment
        e) Creation of user guides
        f) Preparation for evaluation
    2) Training Implementation:
        a) System admin training
        b) Farmer user training
        c) Manager training
        d) Hands-on practice
        e) Troubleshooting guide
        f) Q&A session
c. Limited Trial
    1) Piloting Testing:
        a) Selection of piloting groups
        b) Setup environment trial
        c) Usage monitoring
        d) Feedback collection
        e) Performance analysis
        f) Identify the problem
    2) User Acceptance Test:
        a) Verify functionality
        b) Data validation
        c) Testing offline scenarios
        d) Sync test
        e) Stress testing
        f) Security testing
d. Initial Evaluation of Use
    1) Monitoring System:
        a) Performance monitoring
        b) Error tracking
        c) Usage statistics
        d) User behavior analysis
        e) Resource utilization
        f) Security monitoring
    2) Feedback Collection:
        a) User surveys
        b) User Interview
        c) Log analysis
        d) Response time tracking
        e) Bug reports
        f) Feature requests
e. Bug and Error Fixes
    1) Bug Fixing:
        a) Bug identification
        b) Priority of repairs
        c) Testing improvements
        d) Deployment fixes
        e) Change documentation
        f) Verify results
    2) Performance Tuning:
        a) Query optimization
        b) Cache implementation
        c) Code optimization
        d) Memory management
        e) Connection pooling
        f) Resource allocation
f. Performance Optimization
    1) System Optimization:
        a) Database tuning
        b) Network optimization
        c) Application caching
        d) Load balancing
        e) Storage optimization
        f) Background job scheduling
    2) User Experience:
        a) UI/UX improvements
        b) Response time
        c) Offline experience
        d) Error handling

e) Form validation
f) Navigation flow

g. Implementation Documentation
   1) Technical Documentation:
      a) System architecture
      b) Configuration details
      c) Maintenance procedures
      d) Backup procedures
      e) Security protocols
      f) Troubleshooting guide
   2) User Documentation:
      a) User manual
      b) Quick start guide
      c) Video tutorials
      d) FAQ document
      e) Best practices
      f) Tips and tricks

h. Support System Setup
   1) Help Desk:
      a) Setup support channel
      b) Ticket system
      c) Knowledge base
      d) Contact procedures
      e) Escalation process
      f) Response time standards
   2) Maintenance Plan:
      a) Regular maintenance schedule
      b) Backup procedures
      c) Update strategy
      d) Security patches
      e) Performance monitoring
      f) Disaster recovery

i. Knowledge Transfer
   1) Team Training:
      a) Technical training
      b) Operational procedures
      c) Security protocols
      d) Troubleshooting
      e) Maintenance tasks
      f) Emergency procedures
   2) Documentation Handover:
      a) System documentation
      b) Source code
      c) Configuration files
      d) Security policies
      e) Backup procedures
      f) Recovery plans

The output of this implementation stage is in the form of:

a. Running System
b. Full Documentation
c. Training Results

Stage of Evaluation

a. Overall System Evaluation
   1) Technical Evaluation:
      a) System performance
         - Response time
         - Throughput
         - Resource utilization
         - Database performance
         - Network efficiency
         - Storage usage
      b) Reliability
         - Uptime percentage
         - Error rate
         - Recovery time
         - Backup success rate
         - Data integrity
         - System stability
   2) Functional Evaluation:
      a) Offline Feature
         - Successful offline operations
         - Data synchronization
         - Local storage efficiency
         - Conflict resolution
         - Data consistency
      b) Online Feature
         - API performance
         - Real-time updates
         - Data synchronization
         - Integration success
         - Connection handling

b. Effectiveness Testing
   1) Metrics Evaluation:
      a) Quantitative
         - User adoption rate
         - Transaction success rate
         - Data accuracy
         - System availability
         - Response times
         - Error frequency
      b) Qualitative
         - User satisfaction

- Ease of use
- Learning curve
- Problem resolution
- Support effectiveness

2) Business Impact:
   a) Operational Efficiency
      - Time savings
      - Cost reduction
      - Resource optimization
      - Process improvement
      - Error reduction
   b) Value Addition
      - ROI measurement
      - Productivity gains
      - Decision support
      - Data accessibility
      - Information quality

c. User Feedback Collection
   1) Collection Method:
      a) Survey
         - User satisfaction surveys
         - Feature evaluation
         - Support quality
         - Training effectiveness
         - System usability
      b) Interview
         - In-depth interviews
         - Focus group discussions
         - User experience sharing
         - Pain points identification
         - Improvement suggestions
   2) Analysis Tools:
      a) Usage Analytics
         - User behavior tracking
         - Feature utilization
         - Access patterns
         - Error tracking
         - Performance metrics
      b) Feedback Processing
         - Data categorization
         - Priority assessment
         - Trend analysis
         - Impact evaluation
         - Action planning

d. Analysis of Advantages and Disadvantages
   1) Strength Analysis:
      a) Technical Strengths
         - System reliability
         - Performance efficiency
         - Security measures
         - Offline capabilities
         - Data management
      b) Functional Strengths
         - User interface
         - Feature completeness
         - Integration capability
         - Customization options
         - Support system
   2) Weakness Analysis:
      a) Technical Limitations
         - Performance bottlenecks
         - Resource constraints
         - Integration challenges
         - Security vulnerabilities
         - Scalability issues
      b) Functional Gaps
         - Missing features
         - Usability issues
         - Process inefficiencies
         - Training needs
         - Support limitations

e. Repair Recommendations
   1) Short-term Improvements:
      a) Technical Updates
         - Bug fixes
         - Performance optimization
         - Security patches
         - UI/UX enhancements
         - Database optimization
      b) Functional Updates
         - Feature additions
         - Process improvements
         - Training updates
         - Documentation updates
         - Support enhancement
   2) Long-term Strategy:
      a) System Evolution
         - Architecture improvements

- Technology upgrades
- Scalability planning
- Integration expansion
- Feature roadmap

b) Organizational Changes
- Process refinement
- Training program
- Support structure
- Resource allocation
- Change management

f. Documentation of Evaluation Results
1) Technical Documentation:
a) Performance Reports
- System metrics
- Resource utilization
- Error logs
- Security audit
- Backup verification

b) Analysis Reports
- Usage statistics
- Problem areas
- Solution effectiveness
- Implementation status
- Improvement recommendations

2) User Documentation:
a) Feedback Report
- User satisfaction
- Feature requests
- Problem reports
- Training effectiveness
- Support quality

b) Impact Analysis
- Business benefits
- Operational improvements
- Cost savings
- Productivity gains
- ROI assessment

The output of this Evaluation stage is in the form of:
a. Evaluation Reports
b. Improvement Plan
c. Documentation Updates

D. Conclusion

The focus of this research is the development of a management information system for agricultural businesses that is specifically designed for areas with limited internet access using the ADDIE instructional design model approach.

The implementation of the ADDIE Method includes five stages, namely:
a. Analysis: Analyzing system needs and internet access constraints in agricultural areas
b. Design: Designing a system that can operate with internet limitations
c. Development: Developing the system according to the results of analysis and design
d. Implementation: Deploying the system in an environment with limited internet access
e. Evaluation: Evaluating the effectiveness of the system in overcoming limitations

The technical aspect of this study is to design a system with offline-first features that can optimize data synchronization when a connection is available by considering local storage and caching.

This research contributes as a practical solution for agricultural business management in remote areas to improve the efficiency of agricultural data management.

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