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СОГЛАСОВАНО

Заведующий кафедрой
фундаментальной
и прикладной математики
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УЧЕБНО-МЕТОДИЧЕСКИЙ КОМПЛЕКС
ПО УЧЕБНОЙ ДИСЦИПЛИНЕ

PROJECT MANAGEMENT IN THE FIELD OF INFORMATION
TECHNOLOGY
УПРАВЛЕНИЕ ПРОЕКТАМИ В СФЕРЕ ИНФОРМАЦИОННЫХ
ТЕХНОЛОГИЙ

7-06-0612-02 Computer Science and Programming Technologies
7-06-0612-02 Информатика и технологии программирования

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Рассмотрено и утверждено
на заседании кафедры фундаментальной
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1 EXPLANATORY NOTE
to the electronic educational and methodological complex
of the discipline "Project management in the field of information technology"
for the specialty
7-06-0612-02 Computer Science and Programming Technologies

The educational and methodological complex on the subject "Project management in the field of information technology " is a set of systematized educational, methodological and auxiliary materials intended for use in the educational process in the specialty 7-06-0612-02- Computer Science and Programming Technologies

1. Regulation on the educational and methodological complex at the level of higher education, approved by the Resolution of the Ministry of Education of the Republic of Belarus dated July 26, 2011 No. 167.

2. Requirements Advanced Higher Education (Master Studies) Speciality 7-06-0612-02 Computer Science and Programming Technology Degree Master of Science.

3. Curriculum of the specialty 7-06-0612-02 Computer Science and Technology and Programming, approved on 28.05.2024 (registration No. 7-0612-0224/ИИ).

These documents provide for the acquisition by master's students of theoretical and practical foundations of activities in the field of project management in the field of information technology; the formation of skills and abilities in using project management tools in the activities of business entities. They include the task of forming professional and personal competencies in the field of economic activity related to the creation and promotion of information technologies and products. Currently, there is a growing quantitative and qualitative need for training qualified specialists for existing IT companies, for the formation of a new entrepreneurial environment (the emergence of start-ups, innovative entrepreneurship, infrastructure for commercialization and technology transfer). IT specialists need knowledge and practical skills in project management, especially for the promotion of their own IT products. Studying the discipline "Project management in the field of information technology" will allow undergraduates to quickly adapt to doing business in their profession, make more informed decisions on choosing a specific future direction of their activities, and analyze their entrepreneurial potential.

The purpose of the educational and methodological complex "Project management in the field of information technology" is to provide theoretical and practical training for students, to intensify their educational and cognitive activities on project management, to develop professional and personal competencies in this area, to improve the skills and abilities of independent educational work.

The objectives of the educational and methodological complex are:

– disclosure of the requirements for the content of the academic discipline "Project management in the field of information technology"; – ensuring successful acquisition of theoretical material on the subject,

- actualization of the use of traditional forms and methods of knowledge control and stimulation of innovative approaches to testing and assessment of knowledge, skills and abilities of master's degree students;
- increasing the level of creative activity of master's degree students through the implementation of various types of creative tasks and problem-search tasks.

Structurally, the educational and methodological complex "Project management in the field of information technology" includes four sections: theoretical, practical, knowledge control section, auxiliary.

The theoretical section contains the main provisions brought out in lectures and intended both for classroom work with master's degree students and for independent study outside the classroom. Through these topics, master's degree students can get an idea of the main directions in the field of project management; about manager's tools; about project risk management, about the problems of team formation. In preparing the theoretical part, educational and scientific literature on project management, as well as information from Internet resources, were widely used.

The practical section includes practical classes in accordance with the curriculum of the discipline. Each lesson topic consists of a list of questions for oral discussion of the content of the lesson topic (recognition level), a list of tasks (level of development of skills and abilities), assignments for written knowledge control (reproduction level), creative tasks (level of application of knowledge in practice). A list of primary and secondary literature is provided for independent study and more in-depth preparation for practical classes. Various forms of work with master's students are assumed during practical classes: oral survey, defense of abstracts, test assignments, group discussion, preparation of presentations, etc. A special place is occupied by the use of the project method. When developing a project, master's students were asked to disclose the following points: business idea; team, roles, title; goal, mission, subject and object; marketing research in the chosen field of activity; project and its description; planning of project work (stages); presentation and defense of the project. Work on projects requires additional self-study, creative thinking, and updating of acquired knowledge from various fields in solving a specific problem from graduate students. These forms of work contribute not only to the acquisition of knowledge and its reproductive reproduction, but also to seeing the patterns of project management.

The knowledge control section is presented by the criteria for assessing the results of graduate students' academic activities in the discipline. It contains exam questions, assessment criteria, sample test tasks, and a criterion for assessing computer testing. This section also contains a sample of test tasks designed to check the level of academic competencies of graduate students in the discipline. They are compiled in a logical sequence and cover all topics of the academic discipline. The presented test tasks are original and are based on the lecture material contained in the educational and methodological complex, as well as additional sources recommended for independent study. Pedagogical tests include an element of choice - options for choosing the correct answers, which are formulated in the form of true

or false statements. The auxiliary section contains the necessary elements of the educational and program documentation: the educational program for the discipline "Project management in the field of information technology" of the educational institution with an explanatory note and the content of the educational material.

The educational and methodological complex of the academic discipline "Project management in the field of information technology" is intended for advanced higher education (master studies) Speciality 7-06-0612-02 Computer Science and Programming Technology Degree Master of Science.

Total number of hours - 90 hours; classroom number of hours - 40 hours (3 credit units), of which lectures - 20 hours (of which students' guided independent work is 4 hours), practical classes - 20 hours. Reporting form - exam (1 semester).

2 THEORETICAL SECTION

2.1 Brief lecture notes

1 Project Management. Definitions and Concepts

1. Project as the Basis of Innovation

Project: A temporary endeavor aimed at creating a unique product, service, or result with a defined beginning and end.

Innovation: Implementation of new or significantly improved products, processes, or methods.

Connection:

Projects are the primary mechanism for delivering innovation.

Innovation requires unique solutions and approaches, aligning with the nature of projects.

Project work enables organizations to move beyond routine operations to create new value.

Successful projects transform ideas into tangible innovative outcomes.

2. Project Success Criteria

Traditional Approach ("Iron Triangle"):

Scope: Delivering all planned work and meeting objectives.

Time: Completing the project within the scheduled timeframe.

Cost: Delivering the project within the approved budget.

Modern Approach:

Customer/Stakeholder Satisfaction: The outcome meets expectations and delivers benefits.

Quality: The result complies with requirements and quality standards.

Expected Benefits/Value: The project achieves planned business goals and adds value.

Team: Maintaining team motivation and effectiveness.

Minimizing Negative Impact: Managing risks and changes proactively.

3. Project and Organizational Structure

Impact of Structure on Projects:

Functional: Projects run within departments; weak PM authority; resource conflicts.

Projectized: Dedicated teams; strong PM authority; potential resource duplication.

Matrix (Weak/Balanced/Strong): Dual reporting (functional and project).

Balances PM/functional manager authority. Most common.

Project Management Office (PMO): Centralized unit providing standards, methodologies, support, and oversight for projects.

4. Project Team Organization

Key Roles:

Project Manager (PM): Accountable for achieving project goals.

Project Team: Specialists performing project work.

Sponsor: Secures resources, provides support, and makes key decisions.

Customer/User: Defines requirements and accepts deliverables.

Team Formation Principles:

Recruiting required competencies.

Clear role definitions (e.g., RACI matrix).

Fostering positive team culture and communication.

Motivating and developing team members.

Accounting for team development stages (Tuckman's Model: Forming, Storming, Norming, Performing, Adjourning).

5. Project Life Cycle (PLC)

Definition: Sequence of phases a project undergoes from initiation to closure.

Typical Phases:

1. Initiation: Defining necessity, goals, key stakeholders. Developing the Project Charter. Decision: Proceed or not?

2. Planning: Detailed development of the Project Management Plan (scope, schedule, cost, risks, quality, resources, communications, stakeholders, procurement). Critical for success.

3. Execution: Implementing the plan. Performing work, managing team, communications, quality, stakeholders, and procurements.

4. Monitoring & Controlling: Tracking progress, comparing to plan, identifying deviations, managing changes/risks. Runs parallel to Execution.

5. Closing: Formal project/phase closure. Delivering outputs, closing contracts, documenting lessons learned, releasing resources.

Variability: Phase duration/detail depends on project size, complexity, and methodology (e.g., Waterfall, Agile).

2 Project Initiation

1. Project Priority Management

Purpose: Ensure projects align with strategic goals and optimize resource allocation.

Key Activities:

- Strategic Alignment: Select projects supporting organizational vision/objectives.
- Scoring Models: Evaluate projects based on criteria (e.g., ROI, risk, strategic value).
- Portfolio Balancing: Balance short/long-term, high/low-risk initiatives.
- Resource Allocation: Assign resources based on priority.

Tools: Cost-benefit analysis, NPV, scoring matrices, portfolio dashboards.

2. Project Concept

Definition: High-level description of the project's purpose and value.

Components:

- Problem/Opportunity: The need the project addresses (e.g., "Reduce customer wait times by 30%").
- Solution Approach: Core idea/methodology (e.g., "Implement AI chatbot support").
- High-Level Benefits: Expected outcomes (e.g., "Improve customer satisfaction").

Output: Project Concept Note/Statement.

3. Project Objectives and Deliverables

Objectives: SMART Criteria: Specific, Measurable, Achievable, Relevant, Time-bound.

Example: "Launch mobile app (iOS/Android) by Q3 2025, achieving 50K downloads in 6 months."

Deliverables:

- Tangible Outputs: Products, documents, or services (e.g., "CRM software," "User training manual").
- Acceptance Criteria: Standards deliverables must meet (e.g., "Complies with GDPR").

4. Assumptions and Constraints

Assumptions:

- Factors considered true without proof (e.g., "Key stakeholders will provide

timely feedback").

- Risk: If false, they become risks.

Constraints:

- Fixed limitations impacting execution (e.g., "Budget capped at \$200K," "Must use Azure cloud").

- Types: Scope, schedule, budget, resources, quality.

5. Key Participants and Stakeholders

Roles:

- Sponsor: Funds project, champions vision, resolves issues.
- Project Manager: Leads planning/execution.
- Core Team: Delivers work.
- Customers/Users: Define needs, use deliverables.

Stakeholder Analysis:

- Identification: List all affected parties (internal/external).
- Assessment: Map power, interest, influence (Power/Interest Grid).
- Engagement Strategy: Tailor communication for each group.

Output: Stakeholder Register.

3 Software Development Methodologies

1. The Waterfall Model

Concept: Linear, sequential approach with distinct phases:

Requirements → Design → Implementation → Testing → Deployment → Maintenance.

Key Principles:

- Rigid phase completion: No overlap; each phase must finish before the next begins.

- Heavy documentation: Detailed specs upfront.

- Minimal customer involvement until delivery.

Pros: Simple structure, easy to manage, clear milestones.

Cons: Inflexible to changes, late error detection, poor fit for ambiguous requirements.

Best For: Stable, well-defined projects with fixed scope (e.g., regulatory systems).

2. Fundamental Principles of the Agile Manifesto

Core Values (from the 2001 Manifesto):

1. Individuals and interactions over processes and tools.
2. Working software over comprehensive documentation.
3. Customer collaboration over contract negotiation.
4. Responding to change over following a plan.

Key Practices:

- Iterative development (sprints/cycles).
- Continuous feedback from customers/stakeholders.
- Embrace changing requirements.
- Self-organizing cross-functional teams.

3. SCRUM, Lean, and Kanban

SCRUM

- Framework: Time-boxed iterations (Sprints , 1–4 weeks).
- Roles: Product Owner (prioritizes backlog), Scrum Master (facilitates), Development Team.
- Artifacts: Product Backlog (all features), Sprint Backlog (current work).
- Events: Sprint Planning, Daily Stand-up, Sprint Review, Retrospective.

Lean

- Goal: Maximize value by eliminating waste (muda).
- Principles:
 - Optimize flow (reduce bottlenecks).
 - Empower teams.
 - Build quality in (automated testing).
 - Defer decisions until "last responsible moment."

Kanban

- Visual Workflow: Kanban board (Columns: To Do, In Progress, Done).
- Core Rules:
 - Limit Work-in-Progress (WIP) to avoid overload.
 - Manage flow (optimize lead time).
 - Continuous improvement (Kaizen).
- Flexibility: No fixed iterations; pull-based system.

Aspect	Agile	Classical (Waterfall)
Requirements	Evolve iteratively; flexible	Fixed upfront; rigid
Customer Involvement	Continuous collaboration	Limited (mainly at start/end).
Delivery	Incremental (working features early).	Single release at project end.
Flexibility	High (embraces change).	Low (change = costly delays).
Risk Management	Early issue detection via feedback	Late testing → high failure risk
Documentation	Minimal ("just enough").	Extensive upfront specs
Team Structure	Cross-functional, self-organizing	Hierarchical, role-based.
Best For	Complex, dynamic projects (e.g., apps).	Predictable, stable projects

Key Takeaways:

- Waterfall: Predictable but inflexible → suits simple, static projects.
- Agile/Scrum: Adaptive, customer-centric → ideal for complex, evolving work.
- Kanban/Lean: Focus on flow & waste reduction → excels in maintenance/service environments.
- Hybrid Models (e.g., Wagile) blend Agile flexibility with Waterfall structure for balance.

No "best" methodology: Choose based on project complexity, team culture, and stakeholder needs.

4 Project planning

1. Defining Project Scope & Stakeholders

Scope:

- What's Included: Explicit deliverables, features, and boundaries.
- What's Excluded: Clarifies out-of-scope items to prevent creep.
- Tools: Scope Statement, Work Breakdown Structure (WBS).

Stakeholders:

- Identification: Map all parties (sponsors, users, regulators, teams).
- Engagement Plan: Define communication frequency/method per group.
- Outputs: Scope Baseline , Stakeholder Register .

2. Project Work Structure & Deadlines

Work Breakdown Structure (WBS):

- Hierarchical decomposition of deliverables → manageable tasks (work packages).
- Rule: 100% Rule (covers all scope; nothing extra/missing).

Deadlines:

- Milestones: Key checkpoints (e.g., "Prototype approved by March 30").
- Dependencies: Sequence tasks (FS, SS, FF, SF).
- Output: Scheduled Baseline (approved timeline).

3. Project Budget Models

Model	Fixed Price	Time & Materials (T&M)
Definition	Pre-agreed total cost	Pay for actual effort/resources used
Risk Owner	Vendor (bears cost overruns).	Client (absorbs variability).
Flexibility	Low (scope changes costly)	High (adapts to evolving needs)
Best For	Well-defined projects	Agile/R&D projects with unclear scope

4. Schedule Management Planning

Process:

1. Define Activities: Break WBS work packages into tasks.
2. Sequence Tasks: Network diagrams (PDM).
3. Estimate Durations: Expert judgment, analogous/parametric estimation.
4. Develop Schedule: Gantt charts, Critical Path Method (CPM).

Critical Path: Longest task sequence → determines project duration.

5. Activities & Resource Planning

Activity Definition:

- Task list with owners (use RACI matrix).

Resource Requirements:

- Human: Skills/roles (developers, testers).
- Material: Hardware, software licenses.
- Financial: Budget allocation per phase.

Tools: Resource Breakdown Structure (RBS) , Resource Calendar .

6. Risk Management & PERT Evaluation

Common Project Risks:

- Scope creep, budget overruns, delays, resource shortages, tech failures.

Risk Response Strategies:

- Avoid, Mitigate, Transfer, Accept.

PERT (Program Evaluation Review Technique):

- Purpose: Estimate task durations under uncertainty.
- Formula: 'Expected Time = (Optimistic + 4×Most Likely + Pessimistic) / 6'
- Example: Optimistic = 10 days, Likely = 15, Pessimistic = 25
$$(10 + 4 \times 15 + 25) / 6 = 16.7 \text{ days}$$

Key Outputs of Planning:

- Project Management Plan: Integrates scope, schedule, cost, risk baselines.
- Risk Register: Logs risks, responses, owners.
- Resource Allocation Schedule: Matches tasks to team/resources.

Why Planning Matters:

- "Failing to plan is planning to fail." A robust plan:
- Aligns stakeholders,
- Exposes risks early,
- Provides benchmarks for control,
- Increases project success by 40% (PMI).

5 Project Risk Management

1. Risk Management Planning

Goal: Establish a structured approach to identifying, analyzing, and responding to risks.

Key Deliverable: Risk Management Plan (RMP) containing:

- Methodology: Tools/techniques (e.g., PERT, Monte Carlo).
- Roles: Risk owners, team responsibilities.
- Budget/Time: Resources allocated for risk activities.
- Risk Thresholds: Tolerance levels (e.g., "Max \$10K cost overrun acceptable").
- Reporting Formats: Risk register templates, review frequency.

2. Risk Identification

Goal: Proactively uncover potential threats and opportunities.

Techniques:

- Brainstorming: Team workshops.
- Checklists: Industry-specific risk catalogs.
- SWOT Analysis: Strengths, Weaknesses, Opportunities, Threats.
- Assumption Analysis: Validate project assumptions.
- Expert Judgment: Consult specialists.

Output: Risk Register (Initial list of risks with causes/effects).

3. Qualitative & Quantitative Risk Analysis

Qualitative Analysis

- Purpose: Prioritize risks via Probability & Impact assessment.
- Tool: Probability-Impact Matrix (Risks mapped as High/Medium/Low).
- Focus: Subjective evaluation (e.g., "High chance of vendor delay → Major schedule impact").

Quantitative Analysis

- Purpose: Numerically estimate risk effects on objectives (cost, schedule).
 - Tools:
 - Expected Monetary Value (EMV): $\text{'Probability} \times \text{Impact'}$.
- Example: 20% chance of \$50K loss → $\text{EMV} = \$10\text{K}$.
- Monte Carlo Simulation: Forecasts project outcomes under uncertainty.
 - Sensitivity Analysis: "Tornado diagrams" show most critical risks.
 - Output: Updated Risk Register with prioritized, quantified risks.

4. Risk Response Planning

Strategies for Threats:

- Avoid: Eliminate the risk (e.g., change scope/technology).
- Mitigate: Reduce probability/impact (e.g., add testing, redundancy).
- Transfer: Shift to third party (e.g., insurance, outsourcing).
- Accept: Do nothing (for low-priority risks; document contingency plan).

Strategies for Opportunities:

- Exploit: Ensure opportunity occurs (e.g., allocate best resources).
- Enhance: Increase probability/impact (e.g., add features).
- Share: Partner with another team/vendor.
- Accept: Passive readiness.

Output: Response Actions added to Risk Register; Contingency Reserves (time/budget) allocated.

5. Risk Mitigation Management

Proactive Monitoring:

- Track triggers (e.g., "If supplier misses 1 deadline, activate backup").
- Audit risk responses quarterly.

Contingency Execution:

- Deploy reserves when risks materialize.

Agile Integration:

- Sprint Retrospectives: Review new/evolving risks.
- Backlog Refinement: Add risk-based tasks (e.g., tech spikes).

Communication:

- Report risk status in stakeholder meetings.
- Update Risk Register in real-time.

Key Tools & Outputs

Process	Key Output	Tool
Planning	Risk Management Plan (RMP)	Expert judgment
Identification	Risk Register	SWOT, Brainstorming
Qualitative Analysis	Prioritized Risk List	Probability-Impact Matrix
Quantitative Analysis	Numerical Risk Models	EMV, Monte Carlo
Response Planning	Contingency Plans/Reserves	Risk Response Strategies

Why Risk Management Matters:

- "Risk is not what you don't know; it's what you're sure of that isn't true."
- John Kenneth Galbraith

- Projects with formal risk management are 2.5× more likely to succeed (PMI).
- Mitigation reduces surprises, cost overruns, and scope creep.
- Turns uncertainty into managed opportunities.

6 Team building

1. Leadership vs. Management: Complementary Forces

Key Distinctions:

Leadership	Management
Sets vision & direction	Executes plans & processes
Inspires change	Maintains stability
Focuses on people	Focuses on systems
"Doing the right things"	"Doing things right"

Integrated Approach for Team Building:

- Transformational Leadership:
 - Inspire shared vision (e.g., "We'll revolutionize patient care through AI").
 - Encourage innovation & intellectual stimulation.
- Servant Leadership:
 - Prioritize team growth/well-being ("How can I remove blockers for you?").
- Managerial Essentials:
 - Clarify roles (RACI), set KPIs, track progress.
 - Balance: Leaders energize; managers systematize. Example: A leader motivates during uncertainty; a manager adjusts timelines/resources.

"Management is about coping with complexity; leadership is about coping with change." Peter Drucker

2. Motivation: Science & Practice

Core Theories:

- Maslow's Hierarchy:
 - Fulfill basic needs (salary, safety) → enable growth (autonomy, purpose).
- Herzberg's Two Factors:
 - Hygiene Factors: Prevent dissatisfaction (fair pay, job security).
 - Motivators: Drive engagement (recognition, responsibility, growth).
- Self-Determination Theory (SDT):
 - Fuel intrinsic motivation via:
 - Autonomy: Ownership over tasks.
 - Mastery: Opportunities to develop skills.
 - Purpose: Meaningful impact ("Our app helps 1M farmers").

Practical Motivational Strategies:

Tool	Application	Impact
Empowerment	Delegate decision-making (e.g., "Choose your sprint tasks")	Boosts ownership/innovation
Recognition	Public praise; spot bonuses	Validates effort; reinforces values
Growth Pathways	Sponsorship for certifications; stretch assignments.	Retains top talent
Feedback Culture	Weekly 1:1s; 360° reviews	Aligns goals; builds trust

Team Building in Action: Synergizing Leadership & Motivation

Step 1: Build Psychological Safety

- Leader's Role: Normalize mistakes ("What did we learn?").
- Manager's Role: Create non-blaming retrospectives.

Step 2: Align Goals

- Use OKRs (Objectives & Key Results):
Objective: "Become #1 in user satisfaction for fintech apps in EU."
Key Result: "Achieve NPS score of 50+ by Q4."

Step 3: Foster Collaboration

- Cross-Functional Projects: Mix developers, marketers, UX designers.
- Virtual Teams: Daily async video updates; virtual "coffee chats."

Step 4: Adapt Styles

Situation	Leadership Approach	Motivational Lever
Crisis	Directive leadership	Highlight purpose ("Our work saves lives")
Creative Phase	Laissez-faire leadership	Autonomy + mastery time
Low Morale	Servant leadership	Recognition + growth talks

Case Study: Google's Project Aristotle

Finding: High-performing teams require:

1. Psychological safety ("Can I take risks here?")
2. Dependability ("Will teammates deliver?")
3. Structure & clarity (Goals, roles, plans)
4. Meaning & Impact

"The best leaders motivate people not by fear or rewards, but by helping them find meaning in their work." Laszlo Bock (Former SVP, Google)

Discussion Questions:

1. How would you resolve tension between a leader's vision and a manager's budget constraints?
2. Design a motivation system for a Gen Z remote team working on climate-tech.
3. Can a toxic superstar be tolerated if they deliver results? Justify ethically.

Further Reading:

- Drive: The Surprising Truth About What Motivates Us (Daniel Pink)
- Leaders Eat Last (Simon Sinek)
- The Five Dysfunctions of a Team (Patrick Lencioni)

Takeaway: Leadership ignites the spark; management sustains the flame; motivation turns it into a blaze. Master all three to build unstoppable teams.

7 Project implementation

1. Work Planning: From Theory to Adaptive Execution

Core Principles:

- Dynamic Replanning: Treat plans as living documents (revise quarterly/sprintly).
- Work Allocation:
 - RACI Matrix: Assign Responsible, Accountable, Consulted, Informed per deliverable.
 - Agile Hybridization: Blend sprints (Scrum) with phase gates (Waterfall) for complex projects.
- Tools:
 - Kanban Boards: Visualize flow (use WIP limits to prevent bottlenecks).
 - Critical Chain Method: Buffer management for resource-constrained scheduling.

Case Example: Construction Project: Used bi-weekly replanning with Last Planner System → reduced delays by 32%.

2. Key Performance Indicators (KPIs): Beyond the Basics

Strategic KPI Framework:

Tier	KPI Examples	Ownership
Strategic	ROI, NPV, Market Share Gain	Sponsor/Steering Committee
Tactical	Schedule Variance (SV), Budget Burn Rate	Project Manager
Operational	Defect Density, Team Velocity	Delivery Team

Advanced Metrics:

- Earned Value Management (EVM):
 - $\text{'CPI} = \text{EV} / \text{AC}$ (Cost Performance Index \rightarrow efficiency)
 - $\text{'SPI} = \text{EV} / \text{PV}$ (Schedule Performance Index \rightarrow timeliness)
- Predictive Indicators:
 - To-Complete Performance Index (TCPI): $\text{'(BAC - EV) / (BAC - AC)}$
 - Required cost efficiency to hit target
- Agile Health Metrics:
 - Flow Efficiency: $\text{'(Value-Add Time / Total Cycle Time) } \times 100\%$
 - Happiness Metric: Team self-assessment (1-10) in retrospectives.

KPI Traps to Avoid:

- Vanity metrics (e.g., "lines of code written").
- Ignoring leading indicators (e.g., stakeholder sentiment decline).

3. Project Completion: Delivering Value & Institutionalizing Learning

Phased Closure Protocol:

1. Technical Closure:
 - Verify deliverables against acceptance criteria (use traceability matrix).
 - Obtain formal sign-off from sponsor/client.
2. Administrative Closure:
 - Terminate contracts/leases.
 - Release resources (team reassignment, asset disposal).
3. Financial Closure:
 - Finalize budgets (compare actual vs. forecast).
 - Close procurement accounts.

Knowledge Capture:

- Lessons Learned Workshop:
 - Ask: "What went well? What failed? How to improve?"
 - Output: Actionable recommendations for PMO.

- Benefits Realization Report:
- Track post-launch outcomes vs. business case (e.g., "6-month user adoption rate").

The Forgotten 20%:

- Stakeholder Transition: Handover to operations team with training.
- Celebration Rituals: Formal recognition → boosts morale for future projects.

Implementation Pitfalls & Mitigation

Risk	Advanced Mitigation Strategy
Scope Creep	Change Control Board with sponsor veto power
Team Burnout	Fatigue Metrics (e.g., overtime >15%) + rotation
Stakeholder Sabotage	Power/Interest grid audits + "back-channel" diplomacy

Tools in Action

- Digital Twins: Simulate project execution (e.g., supply chain disruptions).
- AI Forecasting: Predict delays using historical SPI/CPI data.

Key Takeaways

1. Work Planning ≠ Static: Replan with velocity data & buffer management.
2. KPIs Must Drive Decisions: If SPI < 0.9 → trigger recovery protocol.
3. Closure is a Value Gate: 47% of benefits are lost without post-project tracking (PMI).

➤ "Implementation isn't about perfection—it's about controlled adaptation."

Assignment:

Analyze a failed project (e.g., Knight Capital collapse). Map implementation gaps using EVM/Kanban principles. Propose a master's-level recovery framework.

Further Reading:

- The Lazy Project Manager (Peter Taylor)
- Benefits Realization Management (APM)
- Harvard Business Review: "Why Your Project Needs a Red Team"

8 Project Management Software

Here's a comprehensive lecture for Master's students on Project Management Software, focusing on Atlassian Jira, work planning, probabilistic work completion, and cost accounting.

1. Introduction: The Role of PM Software

Key Concepts:

- Digital Transformation in PM: Shift from spreadsheets to integrated tools for scalability, collaboration, and data-driven decisions.
- Core Functions: Task tracking, resource allocation, risk analysis, financial control, reporting.
- Business Value: Reduced overhead, real-time visibility, predictive analytics, compliance.

Example: NASA's use of Jira for Mars Rover missions to manage 10,000+ tasks across global teams.

2. Atlassian Jira: Agile Powerhouse

a. Architecture & Core Features

- Epics → User Stories → Tasks: Hierarchical work decomposition.
- Boards (Scrum/Kanban): Visual workflow management (To Do → In Progress → Done).
- Custom Workflows: Tailored states (e.g., Design → Code Review → QA → Deploy).
- Dashboards: Real-time metrics (velocity, sprint progress).

b. Advanced Capabilities

- Automation Rules: Auto-assign tasks, escalate blockers, trigger notifications.
- Integrations:
 - Confluence: Documentation linking.
 - Bitbucket/GitHub: Code commit → Task transition.
 - Tempo Timesheets: Effort/cost tracking.
- Add-ons:
 - Advanced Roadmaps: Portfolio-level planning.
 - BigPicture: Program management (Gantt, risk matrices).

c. Limitations

- Steep learning curve for non-tech users.
- Cost scaling with user count.
- Overhead for simple projects.

- Case Study: Spotify's "Squad Model" powered by Jira for 200+ autonomous teams.

3. Work Planning in PM Software

a. Methodologies Supported

Method	Tool Features
Waterfall	Gantt charts, milestone dependencies (MS Project).
Agile	Sprints, backlogs, velocity charts (Jira).
Hybrid	Phase-based boards with iterative cycles (ClickUp)

b. Critical Planning Components

1. WBS Integration: Break down projects into tasks/subtasks.
2. Dependencies: FS, SS, FF (e.g., "Testing can't start until coding finishes").
3. Resource Leveling: Auto-adjust schedules based on team capacity.
4. Baselines: Snapshots of original plans vs. actuals.

➤ Exercise: Build a WBS in Jira for a SaaS launch

(Dev → QA → UAT → Go-Live).

4. Accounting for Probability of Work Completion

a. Probabilistic Scheduling Techniques

- PERT (Program Evaluation Review Technique):

$$\text{Expected Time} = (\text{Optimistic} + 4 \times \text{Likely} + \text{Pessimistic}) / 6$$

Tool Application: Jira plugins (e.g., "PERT for Jira") calculate task confidence intervals.

- Monte Carlo Simulations:

Model 10,000+ scenarios to predict project completion dates.

Tools: Risk, RiskyProject → Integrated with MS Project/Jira.

b. Agile Forecasting

- Velocity Tracking: Avg. story points completed per sprint → Predict future throughput.
- Burn-up Charts: Scope vs. time → "Probability of on-time delivery" based on trendlines.
- Cycle Time Analytics: (e.g., Jira's "Control Chart") → Predict task completion likelihood.

> Formula: `Probability (%) = (Completed Tasks / Total Tasks) × Cycle Time Efficiency`

5. Accounting for Work Costs

a. Cost Tracking Framework

Cost Type	PM Software Features
Labor	Time tracking (Tempo, Harvest) × Hourly rates.
Materials	Purchase order integration (QuickBooks, SAP).
Fixed Costs	Budget baselines (MS Project).
Contingency	Risk-adjusted reserves (RiskyProject)

b. Jira-Specific Cost Management

1. Tempo Timesheets: Log hours against tasks → Auto-calculate labor costs.
2. Budget Reports: Planned vs. actual spend per epic/sprint.
3. ROI Dashboards: Benefit (story points delivered) ÷ Cost (team effort).

c. Advanced Techniques

- Earned Value Management (EVM):
 - $CPI \text{ (Cost Performance Index)} = EV / AC$
 - Tools: Jira + BigPicture EVM module.
- Forecasting:
 - "Cost at Completion" predictions based on current spend trends.

Case Study: Boeing's use of EVM in Jira for aerospace R&D (\$2B+ projects).

6. Comparative Tool Analysis

Function	Jira	MS Project	Smartsheet
Agile Planning	★★★★★	★★☆☆☆	★★★★☆
Probabilistic Sched.	Add-ons	★★★★☆	★★☆☆☆
Cost Control	★★★☆☆ (w/ add-ons)	★★★★★	★★★★☆
Integration	DevOps ecosystems	Microsoft Suite	Google Workspace

7. Discussion Questions

1. How does Jira's agile-centric design limit its use in waterfall projects?
2. Can probabilistic scheduling replace expert judgment? Justify.
3. What cost risks emerge when integrating Jira with external financial systems?
4. Debate: "EVM is obsolete in agile environments."

8. Conclusion & Trends

- AI/ML: Predictive delay/cost overrun alerts (e.g., Jira's "Atlassian Intelligence").
- Unified Platforms: Consolidating planning, risk, cost (e.g., ClickUp, Wrike).
- Ethical Considerations: Data privacy in time tracking/employee monitoring.

3 PRACTICAL SECTION

1. Project management. Definitions and concepts
2. Project initiation
3. Software development methodologies
4. Project planning
5. Project risk management
6. Formation of the project team
7. Project implementation
8. Software in the field of project management.

Task: develop an end-to-end project task for software development, where each task logically follows from the previous one, covering all the specified stages. It should be based on one common project:

General Project Context: Development of an Equipment Tracking System (ETS) for a Mid-Sized IT Company

Goal: Create a web application to track the location, status, and usage history of computer equipment (laptops, monitors, peripherals) within the company.

Stakeholders: IT Infrastructure Department, Procurement Department, Finance Department, Company Employees (equipment users).

1. Project Management: Definitions and Concepts

- Task: Based on the ETS project description:

1. Define the ETS project using key project characteristics (temporality, uniqueness, resource constraints, goals).
2. Explain the difference between a project , program , and portfolio . Which category does ETS belong to?
3. Identify key project roles (sponsor, project manager, team, stakeholders) and assign them for ETS.
4. Describe the "Triple Constraint" (Scope, Time, Cost) as applied to ETS. Specify factors for each dimension.

- Goal: Reinforce basic PM terminology and concepts in a real-world context.

2. Project Initiation

- Task: Using insights from Task 1, initiate the ETS project:

1. Draft a formal Business Case : Why is this project needed? What problems will it solve (e.g., equipment loss, inefficient tracking)? List expected benefits (operational/financial).
2. Identify Key Stakeholders (beyond those listed). Create a Power/Interest Matrix.
3. Develop a Project Charter . Include: Goals, high-level requirements, deliverables, success criteria, high-level risks, assumptions/constraints,

budget/timeline estimates, assigned PM and sponsor.

- Goal: Formally define the project's purpose, boundaries, and key parameters.

3. Software Development Methodologies

- Task: Analyze ETS (based on the Charter from Task 2) and select a suitable methodology:

1. Compare Waterfall , Agile (Scrum/Kanban) , and Hybrid approaches (principles, pros/cons).
2. Justify the choice of one methodology/hybrid model considering ETS requirements (partial clarity, need for stakeholder feedback, iterative delivery).
3. Describe how the chosen methodology will organize work (sprints/iterations, meetings, artifacts).

- Goal: Select and justify an optimal development process.

4. Project Planning

- Task: Using the Charter (Task 2) and chosen methodology (Task 3), create a detailed ETS plan:

1. Work Breakdown Structure (WBS): Decompose the project into work packages (e.g., Requirements Analysis, UX/UI Design, Backend/Frontend Development, AD/LDAP Integration, Testing, Deployment, User Training). Break down to task level.

2. Effort/Duration Estimation: Estimate time/effort for key tasks (using expert judgment/analogous estimation). State assumptions.

3. Network Diagram/Gantt Chart: Build a network diagram, identify the critical path. Create a high-level Gantt chart with phases/milestones.

4. Resource Management Plan: Define roles (analyst, devs, QA, UX/UI designer, DevOps), skills, and FTE needs.

5. Budget: Estimate costs (labor, software, hardware, licenses, training).

6. Communication Plan: Specify information distribution (frequency, recipients, channels).

- Goal: Create a detailed project roadmap.

5. Project Risk Management

- Task: Plan risk management for ETS:

1. Risk Identification: Brainstorm risks (technical, organizational, resource-related, external).

2. Qualitative Analysis: Assess probability (P) and impact (I) for each risk. Prioritize using a P-I matrix.

3. Quantitative Analysis: Estimate schedule/budget impact for critical risks (e.g., Monte Carlo).

4. Response Planning: Define strategies (Avoid/Mitigate/Transfer/Accept)

and actions for top risks.

5. Monitoring Plan: Define risk review frequency/methods.

- Goal: Proactively identify threats/opportunities and plan countermeasures.

6. Formation of the Project Team

- Task: Form the ETS team using the Resource Plan (Task 4.4) and Risk Assessment (Task 5):

1. Recruitment: Specify competency requirements per role (e.g., "Backend Dev: Node.js, MongoDB, REST API").

2. RACI Matrix: Assign Responsible (R), Accountable (A), Consulted (C), Informed (I) for WBS tasks.

3. Team Development: Propose team-building activities for each Tuckman stage (Forming-Storming-Norming-Performing). Align with the chosen methodology.

4. Team Management Plan: Outline motivation, performance evaluation, conflict resolution, and communication tools (e.g., Slack/Jira).

- Goal: Define team composition, roles, responsibilities, and dynamics.

7. Project Implementation

- Task: Simulate ETS project execution with focus on delivery and control:

1. Work Execution: Describe daily operations (stand-ups, sprints, task boards) and artifacts (backlog, increment).

2. Knowledge Management: Outline knowledge-sharing practices (documentation, code reviews, workshops).

3. Quality Assurance (QA): Integrate testing (unit/integration/system/UAT). Define UAT participants and defect tracking.

4. Monitoring & Control: Track KPIs (% completion, burn-down charts, velocity, open bugs). Define change control processes and progress reviews.

5. Reporting: Specify status report formats/recipients/frequency.

- Goal: Describe execution, quality control, progress tracking, and change management processes.

8. Software in Project Management

- Task: Select and justify PM tools for ETS:

1. Planning/Scheduling: MS Project, Jira Advanced Roadmaps, ClickUp.

2. Task/Backlog Management: Jira, Trello, Azure DevOps.

3. Risk Management: Jira/MS Project modules, RiskyProject, Excel templates.

4. Communication/Collaboration: Slack/MS Teams + Confluence/Google Docs.

5. Version Control/CI/CD: Git (GitHub/GitLab), Jenkins.

6. Bug Tracking: Jira, Bugzilla.
7. Recommendation: Propose an integrated toolkit (e.g., Jira + Confluence + Slack + GitLab). Justify based on ETS scope, methodology (Task 3), budget, and team needs.
 - Goal: Define a toolstack supporting end-to-end PM processes.

Usage Guidelines:

1. Sequential Completion: Tasks build on prior results. Start with Task 1.
2. Consistency: All tasks use the unified ETS project context.
3. Depth: Combines theory (Tasks 1, 3) and practice (Tasks 4–8). Adjust detail for audience (students/practitioners).
4. Flexibility: Allow variability in methodology (Task 3) or tools (Task 8) with rationale.
5. Outcome: Completing all tasks provides holistic understanding of SDLC and PM skills.

4 KNOWLEDGE CONTROL SECTION

4.1 Questions for the exam in the academic discipline "Project management in the field of information technology"

1. Recommended list of exam questions
2. Specifics of IT projects
3. Priority of innovative activities at the current stage of economic development.
4. Concept of a project.
5. Basic principles of program-target and project-oriented management.
6. Relationship between project management and functional management.
7. Transition to project management: tasks and stages of solution.
8. Classification of basic project management concepts.
9. Classification of project types.
10. Purpose and strategy of projects. Project result.
11. Project parameter management.
12. Project cycle.
13. General characteristics of software projects.
14. Success factors of an IT solution implementation project.
15. Typical errors in IT project management.
16. Project management processes.
17. Maturity levels of project management processes.
18. Key areas of the IT project management process
19. IT product life cycle models.
20. Relationship between the life cycle of an IT solution and the life cycle of a project.
21. Software project management theories.
22. Classification of software development methods, models and standards.
23. Agile rapid adaptive development methodologies (SCRUM, XP, Crystal).
24. Role (organizational) structure of IT project management
25. Organizational structure of project performers. Concept of function, role, position.
26. Contractor-customer relationships.
27. Key roles.
28. Project manager.
29. Initiation of an IT project.
30. Feasibility study (FS) of an IT project.
31. Project significance criteria: financial and strategic value of the project, risk level.
32. Defining project goals and objectives.
33. Formulating the business goal of the project.
34. Benefit structuring matrix.
35. Identifying the project environment: project stakeholders and analyzing their

- impact on the project.
36. Defining project boundaries.
 37. Developing project management baselines. Types of plans and their purpose.
 38. Managing the project scope and forming the project work breakdown structure (WBS).
 39. Forming the project schedule.
 40. Project deadline management.
 41. Estimating labor intensity based on labor intensity assessment models.
 42. Project resources. Resource allocation patterns.
 43. Developing the project schedule. Critical path method.
 44. Project cost estimation methods.
 45. Identifying and planning project risk management.
 46. Concept of project risk, probability of risk occurrence, risk impact assessment, risk magnitude calculation.
 47. Risk identification and prioritization methods. Most common IT project risks.
 48. Methods of qualitative and quantitative risk analysis. Risk response strategy development.
 49. Project execution management and closure.
 50. Monitoring and control. Control indicators.
 51. Project deadline and schedule management.
 52. Project quality management. Error registration and tracking.
 53. IT project requirements management. Requirements groups according to the FURPS+ model.
 54. Project closure stage and its role in ensuring the maturity of project management processes in the organization..

4.2 Assessment criteria

for the results of academic activities of master's students in the academic discipline "Project management in the field of information technology" (based on the letter of the Ministry of Education of the Republic of Belarus dated 28.05.2013 No. 09-10 / 53-PO)

The ten-point scale, depending on the value of the point and grade, includes the following criteria:

10 (ten) points, passed, is awarded for systematized, deep and complete knowledge of all sections of the curriculum of an institution of higher education in an academic discipline, as well as on key issues that go beyond it; for the accurate use of scientific terminology (including in a foreign language), competent, logically correct presentation of answers to questions; for impeccable mastery of the tools of the academic discipline, the ability to effectively use them in setting and solving scientific and professional problems; for a pronounced ability to independently and creatively solve complex problems in a non-standard situation; for complete and deep assimilation of the main, additional literature on the studied academic discipline; for

the ability to freely navigate the theories, concepts and trends in the studied academic discipline and give them an analytical assessment, use the scientific achievements of other disciplines; for creative independent work in practical, laboratory classes, active creative participation in group discussions, a high level of culture of completing assignments.

9 (nine) points, passed is awarded for systematized, deep and complete knowledge of all sections of the curriculum of an institution of higher education in an academic discipline; for the accurate use of scientific terminology (including in a foreign language), competent, logically correct presentation of answers to questions; for mastering the tools of the academic discipline, the ability to effectively use them in setting and solving scientific and professional problems; for the ability to independently and creatively solve complex problems in a non-standard situation within the framework of the curriculum of an institution of higher education in an academic discipline; for complete mastery of the main and additional literature recommended by the curriculum of an institution of higher education in an academic discipline; for the ability to navigate theories, concepts and trends in the studied academic discipline and to give them an analytical assessment; for systematic, active independent work in practical, laboratory classes, creative participation in group discussions, a high level of culture in completing assignments.

8 (eight) points, passed is awarded for systematized, deep and complete knowledge of all sections of the curriculum of an institution of higher education in an academic discipline within the scope of the curriculum of an institution of higher education in an academic discipline; for the use of scientific terminology (including in a foreign language), competent, logically correct presentation of answers to questions, the ability to make substantiated conclusions and generalizations; for mastering the tools of the academic discipline (methods of complex analysis, information technology techniques), the ability to use them in setting and solving scientific and professional problems; for the ability to independently solve complex problems within the framework of the curriculum of an institution of higher education in an academic discipline; for mastering the basic and additional literature recommended by the curriculum of an institution of higher education in an academic discipline; for the ability to navigate the theories, concepts and trends in the studied academic discipline and to give them an analytical assessment; for active independent work in practical, laboratory classes, systematic participation in group discussions, a high level of culture of completing assignments.

7 (seven) points, passed is awarded for systematized, deep and complete knowledge of all sections of the curriculum of an institution of higher education in an academic discipline; for the use of scientific terminology (including in a foreign language), competent, logically correct presentation of answers to questions, the ability to make well-founded conclusions and generalizations; for mastering the tools of the academic discipline, the ability to use them in setting and solving scientific and professional problems; for free possession of standard solutions within the framework of the curriculum of an institution of higher education in an academic discipline; for mastering the main and additional literature recommended by the

curriculum of an institution of higher education in an academic discipline; for the ability to navigate the main theories, concepts and trends in the studied academic discipline and to give them an analytical assessment; for independent work in practical and laboratory classes, participation in group discussions, and a high level of culture in completing assignments.

6 (six) points, passed, awarded for sufficiently complete and systematized knowledge within the scope of the higher education institution's curriculum in the academic discipline; for the use of the necessary scientific terminology, competent, logically correct presentation of answers to questions, the ability to make generalizations and substantiated conclusions; for mastering the tools of the academic discipline, the ability to use them in solving educational and professional problems; for the ability to independently apply standard solutions within the framework of the higher education institution's curriculum in the academic discipline; for mastering the basic literature recommended by the higher education institution's curriculum in the academic discipline; for the ability to navigate the basic theories, concepts and trends in the discipline being studied and to give them a comparative assessment; for active independent work in practical, laboratory classes, periodic participation in group discussions, a high level of assignment completion culture.

5 (five) points, passed, awarded for sufficient knowledge within the scope of the higher education institution's curriculum in the academic discipline; for the use of scientific terminology, competent, logically correct presentation of answers to questions, the ability to draw conclusions; for mastering the tools of the academic discipline, the ability to use them in solving educational and professional problems; for the ability to independently apply standard solutions within the framework of the curriculum of an institution of higher education in an academic discipline; for mastering the basic literature recommended by the curriculum of an institution of higher education in an academic discipline; for the ability to navigate the basic theories, concepts and trends in the studied academic discipline and give them a comparative assessment; for independent work in practical, laboratory classes, fragmentary participation in group discussions, a sufficient level of culture in completing assignments.

4 (four) points, passed is awarded for a sufficient amount of knowledge within the framework of the educational standard of higher education; for mastering the basic literature recommended by the curriculum of an institution of higher education in an academic discipline; for the use of scientific terminology, logical presentation of answers to questions, the ability to draw conclusions without significant errors; for mastering the tools of the academic discipline, the ability to use them in solving standard (typical) problems; for the ability to solve standard (typical) problems under the guidance of a teacher; for the ability to navigate the main theories, concepts and directions in the studied academic discipline and to evaluate them; for work under the guidance of a teacher in practical and laboratory classes, an acceptable level of culture in completing assignments.

3 (three) points, failed is awarded for an insufficiently complete amount of

knowledge within the framework of the educational standard of higher education; for knowledge of part of the basic literature recommended by the curriculum of an institution of higher education in the academic discipline; for the use of scientific terminology, presentation of answers to questions with significant, logical errors; for poor mastery of the tools of the academic discipline, incompetence in solving standard (typical) problems; for inability to navigate the main theories, concepts and directions in the studied academic discipline; for passivity in practical and laboratory classes, a low level of culture in completing assignments.

2 (two) points, not credited is awarded for fragmentary knowledge within the framework of the educational standard of higher education; for knowledge of individual literary sources recommended by the curriculum of the institution of higher education for the academic discipline; for the inability to use scientific terminology of the academic discipline, the presence of gross, logical errors in the answer; for passivity in practical and laboratory classes, a low level of culture in completing assignments.

1 (one) point, not credited is awarded for lack of knowledge and (competencies) within the framework of the educational standard of higher education, refusal to answer, failure to appear for certification without a valid reason.

Examinees have the right to use the curriculum of the course during the test. The results of the test are announced, as a rule, on the day of the test and are recorded in the examinee's record book and the examination report. Master's students who have not fully met the requirements for studying this discipline are not allowed by the department to take the exam.

4.3 Independent work on the discipline "Project management in the field of information technology"

During the course, graduate students are recommended to use electronic presentations of lectures, laboratory practical training, including examples of solving typical problems, assignments for independent work, and test questions as information and methodological support. The most effective forms and methods of organizing independent work for graduate students are: completing assignments, writing essays.

4.4 Sample test assignments on the academic discipline "Project management in the field of information technology"

1. What are the three main factors that influence software project management?
=Time, cost, quality.
~Time, cost, number of employees.
~Quality, number of employees, budget.
~Time, quality, number of clients.
~Cost, quality, number of clients.

2. What is a product life cycle?
 - ~Software development process.
 - =Stages a product goes through from idea to obsolescence.
 - ~Software testing methodology.
 - ~Project management process.
 - ~Software type.

3. What filters are used in the "Big League" model for selecting ideas?
 - =Competence, organization strategy, market needs.
 - ~Budget, time, quality.
 - ~Number of employees, budget, deadlines.
 - ~Quality, number of clients, budget.
 - ~Time, cost, quality.
- ::3:: Which project life cycle model is sequential?
 - =Waterfall
 - ~RAD
 - ~Spiral
 - ~Prototype
 - ~Agile

4. Which project life cycle model uses an iterative cycle approach?
 - ~Waterfall
 - ~RAD
 - =Spiral
 - ~Prototype
 - ~Agile

5. Which phase in the Waterfall model involves coding the software?
 - ~Gathering Requirements
 - ~Design
 - =Implementation
 - ~Testing
 - ~Deployment

6. What model is used for a successful metrics program strategy?
 - ~Agile.
 - ~Waterfall.
 - =PDCA (Plan-Do-Check-Act).
 - ~Scrum.
 - ~Kanban.

7. What does the "Plan" stage mean in the PDCA model?
 - ~Executing the plan.
 - ~Checking the results.
 - =Planning goals and objectives.
 - ~Taking corrective actions.
 - ~Product testing.

8. What does the "Check" stage mean in the PDCA model?
 - ~Planning.
 - ~Executing.

- =Verifying measurement results.
- ~Decision making.
- ~Documentation.

9. What is important to consider when implementing metrics?

- ~Technical aspects only.
- ~Human factors only.
- =Technical aspects and human factors.
- ~Project budget only.
- ~Due dates only.

10. What is software configuration management (SCM)?

- ~The process of testing code.
- =A set of processes for managing changes to software.
- ~Development team management.
- ~Requirements documentation process.
- ~Project budget management.

11. What is baseline in SCM?

- ~Code testing process.
- =A process by which a set of items is made publicly available.
- ~Development team management.
- ~Requirements documentation process.
- ~Project budget management.

12. What is a "configuration item"?

- ~Requirements document.
- =A baseline of a configuration that must be identified, tracked, and controlled.
- ~A process for testing code.
- ~Managing the development team.
- ~Managing the project budget.

13. What is "change management" in SCM?

- ~A process for testing code.
- =A process for managing change requests and their implementation.
- ~Managing the development team.
- ~Documenting requirements.
- ~Managing the project budget.

14. What is risk in the context of project management

- ~A plan of action to achieve project goals
- =Unpredictable events that may derail the achievement of project goals
- ~A list of tasks that need to be completed
- ~Financial costs for project implementation
- ~The process of monitoring a project

15. Which of the following examples is a risk?

- ~Increasing the project budget
- =Earthquake or flood
- ~Successful completion of the project
- ~Raising employee salaries

~Choosing new software

16. Which characteristic best describes the approach to risk management?

- ~Reactive approach
- =Predicting threats before they occur
- ~Ignoring potential problems
- ~Fixing errors after they occur
- ~Focusing only on current tasks

17. Which stage of the risk management cycle comes first?

- ~Risk assessment
- ~Risk monitoring
- =Risk identification
- ~Risk mitigation
- ~Organizational history analysis

18. Which method is used to identify risks through the analysis of past projects?

- ~Simulations
- ~Decision trees
- =Organizational history review
- ~Checklists
- ~Risk categorization

19. What are checklists used for in risk management?

- ~To record financial costs
- =To ensure no obvious inputs are missed
- ~To automate processes
- ~To determine the probability of risks
- ~To create new projects

20. What categories of risks are identified within a structured approach?

- =Technological, human-related, political, market
- ~ Financial, environmental, social
- ~Time-based, spatial, organizational
- ~Personal, professional, corporate
- ~Legal, technical, economic

4.5 Criteria for assessing the results of the KKR (computer testing)

10 – point scale

10 points = 100% (correct answers)

98% ≤ 9 points ≤ 99%

96% ≤ 8 points ≤ 97%

93% ≤ 7 points ≤ 95%

82% ≤ 6 points ≤ 92%

71% ≤ 5 points ≤ 81%

60% ≤ 4 points ≤ 70%

50% ≤ 3 points ≤ 59%

$40\% \leq 2 \text{ points} \leq 49\%$

1 point < 40%

0 points test not completed

To receive a positive mark (4 points), a graduate student must correctly answer 12 questions out of 20 questions randomly selected by a computer program for the academic discipline.

5 SUPPORTING SECTION

5.1 Curriculum for the academic discipline "Project management in the field of information technology"

Educational institution
"Francisk Skorina Gomel State University"

AFFIRM
Rector
Francisk Skorina GSU
S. A. Khakhomov
24.05.2023
Registration № Уд-2023-286/yz

Module "Management of Software Development Capacity"
**PROJECT MANAGEMENT IN THE FIELD OF
INFORMATION TECHNOLOGIES**
Higher education curriculum
in the academic discipline in the specialty
7-06-0612-02 Computer science and programming technologies

2024

The curriculum is based on the curriculum of the leading educational institution Belarusian State University of Informatics and Radioelectronics, approved on 01.07.2019 (registration number no. UD-5-1224/uch.) and the curriculum of the specialty 7-06-0612-02 Computer Science and Technology and Programming, approved on 22.05.2024 (registration № 7-0612-02.24/uch.).

COMPILED BY:

Marchenko L. N. – Head of the Department of Fundamental and Applied Mathematics of the Francisk Skorina Gomel State University, PhD in Engineering, Associate Professor

RECOMMENDED FOR APPROVAL:

Department of Fundamental and Applied Mathematics of the Francisk Skorina Gomel State University,
(minutes № 9 of 29.04.2025)

Scientific and Methodological Council of the Francisk Skorina Gomel State University
(minutes № 9 of 24.05.2023)

EXPLANATORY NOTE

Software development is in most cases considered as a collective work of specialists aimed at satisfying the needs of users in the automation of their activities. Therefore, software development requires special organization, in particular management. A necessary element of software development is the solution of problems of studying users, on the one hand, and on the other - providing them with feedback that guides production. An important point here is the specificity of custom work, when the entire production of a program from the concept stage to its transfer into operation is financed by external, in relation to the developers, but very interested customers. The next important characteristic of software development is the desire to reuse previously created software components. A special place is occupied by the task of distributing the built software product. Therefore, studying the discipline "Project Management in the Sphere of Information Technology" is a necessary and relevant aspect in the training of specialists in advanced higher education, and meets the requirements of the present day. This curriculum defines the goals and objectives of studying the discipline "Project Management in Information Technology" by master's students majoring in 7-06-0612-02 Computer Science and Programming Technologies, its content and structure, requirements for the results of educational activities and the form of certification.

The knowledge gained while studying the discipline "Project Management in Information Technology" can be used when writing a master's thesis and in the professional activities of a master's student in the specialty.

In this course, master's students will be offered to study the trends in the development of information systems, models and methods of data processing, learn how to manage software development and projects, prepare and conduct testing of a software product, get acquainted with and master the tools used by quality control engineers, plan and manage project deadlines, learn how to evaluate the effectiveness of each project participant for the reporting period, which determines the relevance of studying this academic discipline.

The academic discipline "Project Management in Information Technology" refers to the state component and is included in the module "Quality Management of Software Development". The objective of the academic discipline: to develop systematized knowledge about software development process management and to study methods of organizing work in software development teams.

Objectives of the academic discipline:

- to acquire knowledge about software development processes and practical recommendations for organizing the work of programming teams and managing such teams;

- to develop knowledge in master's students related to the software development process, including connections with the subject area, implementation, production organization, control over deadlines and quality;

- to develop knowledge about technical software and technological solutions used in software development;

- to develop skills in designing, implementing, assessing the quality and analyzing the effectiveness of software;

- to develop practical skills in working in a team of programmers, the ability to find the right technological solutions for choosing the structure of a software project, testing methods and monitoring the implementation of modern instrumental and methodological means.

As a result of studying the academic discipline, the master's student should:

know:

- the main phases of the software development process;

- the distribution of roles in the project team;

- methods for assessing the labor intensity of projects;

- methods for assessing project risks;

- methods of monitoring the progress of the project;

be able to:

- distribute roles in the project team;

- decompose the project into tasks, draw up a project plan, assess labor costs and risks;

- choose a project risk management strategy;

- use project planning tools;

- use version control tools;

be proficient in:

- classical methodologies for managing the software development process;

- "agile" methodologies for managing the software development process.

As a result of studying the academic discipline "Project Management in Information Technology", the following competencies are formed:

UK-4. Ensure communications, demonstrate leadership skills, be capable of team building and developing strategic goals and objectives.

UPC-2. Manage groups (teams) of employees, projects and networks taking into account the selected methodology and technology of software development.

Educational aspects of studying the discipline. The study of the elective academic discipline "Project Management in the Sphere of Information

Technology" is aimed at improving the quality of the educational process through the formation of systemic and logical thinking, responsibility for the results of studies.

CONTENT OF THE TRAINING MATERIAL

Topic 1 Project management. Definitions and concepts

A project is the basis of innovation. Project success criteria. Project and organizational structure of the company. Project team organization. Project life cycle. Phases and products

Topic 2 Project initiation

Project priority management. Project concept. Project goals and results. Assumptions and limitations. Key participants and stakeholders. Resources. Deadlines. Risks. Acceptance criteria. Justification of the project's usefulness.

Topic 3 Software development methodologies

Waterfall model. Rational Unified Process. Advantages and disadvantages of classical methodologies, their applicability. Fundamental principles of the Agile Manifesto. SCRUM, Lean and Kanban - general description, basic terminology and principles. Comparison of flexible and classical methodologies. Roles in SCRUM. Working with a product backlog (project content management). Story Points and Planning Poker Assessment. Sprint Planning Meeting Rules. Metrics and Performance Control.

Topic 4 Project Planning

Defining the Project Scope. Identifying Stakeholders. Defining the Project Work. Defining the Project Timeline. Basic Project Risks. Defining the Project Budget (Fixed Price or Time & Materials). Planning Schedule Management. Defining the Operations and Resources Required to Implement the Project. Project Evaluation Methodology (PERT). Schedule Control.

Topic 5 Project Risk Management

Planning Risk Management. Risk Identification. Qualitative and Quantitative Risk Analysis. Risk Response Planning. Project Management Aimed at Risk Mitigation. Risk Monitoring and Control.

Topic 6 Team Building

Leadership and Management. The Right People. Motivation. Effective Interaction. Building Trust with the Team. Salary and Bonuses. Planning Employee Career Paths. Gamification.

Topic 7 Project Implementation.

Work Planning. Quantity Management. Key Performance Indicators. Completion of the project

Topic 8 Project management software

Atlasian Jira. Creating a work plan. Accounting for the probability of work completion. Accounting for the cost of work.

**EDUCATIONAL AND METHODOLOGICAL CARD OF THE ACADEMIC DISCIPLINE PROJECT
MANAGEMENT IN THE SPHERE OF INFORMATION TECHNOLOGIES**
full-time form of obtaining advanced higher education

Section number, topics	Section title, topic	Number of classroom hours Number of hours		Independent educational work		Knowledge control form
		Lectures	Practical classes	Lectures	Practical classes	
1	2	3	4	8		9
1	Project Management. Definitions and Concepts 1. Project as the basis of innovation. 2. Project success criteria. 3. Project and organizational structure of the company. 4. Organization of the project team. 5. Project life cycle.	2	-	-	2	Oral survey,
2	Project Initiation 1. Project Priority Management. 2. Project Concept. 3. Project Objectives and Deliverables. 4. Assumptions and Constraints. 5. Key Participants and Stakeholders.	-	-	2	2	Group consultation
3	Software Development Methodologies 1. The Waterfall Model. 2. The Fundamental Principles of the Agile Manifesto. 3. SCRUM, Lean, and Kanban. 4. Comparison of Agile and Classical Methodologies.	2	2	-	-	Oral survey, Group consultation

4	Project planning 1. Defining the project scope and stakeholders. 2. Defining the project work structure and project deadlines. 3. Defining the project budget (Fixed price or Time & Materials). 4. Planning schedule management. 5. Defining the activities and resources required to implement the project. 6. Basic project risks. Project evaluation methodology (PERT).	-	-	2	2	Group consultation
5	Project Risk Management 1. Risk management planning. 2. Risk identification. 3. Qualitative and quantitative risk analysis. 4. Risk response planning. 5. Project management aimed at risk mitigation.	2	2	-	-	Oral survey, Group consultation
6	Team building 1. Leadership and management. 2. Motivation. 3. Effective interaction. 4. Salaries and bonuses.	-	2	2	--	Oral survey, Group consultation
7	Project implementation. 1. Work planning. 2. Key performance indicators. 3. Project completion	-	-	2	2	Group consultation
8	Project Management Software 1. Atlassian Jira. 2. Work Planning. 3. Accounting for the Probability of Work Completion. 4. Accounting for Work Costs	2	-	2	-	Oral survey, Group consultation
	Total	6	6	10	10	

Head of the Department of Fundamental and Applied Mathematics,

Francisk Skarina Gomel State University, Ph.D. in Technics, Associate Professor

_____ L.N. Marchanka

INFORMATION AND METHODOLOGICAL PART

List of topics for practical classes

1. Project management. Definitions and concepts
2. Project initiation
3. Software development methodologies
4. Project planning
5. Project risk management
6. Formation of the project team
7. Project implementation
8. Software in the field of project management

Means of diagnostics of the results of educational activities

The assessment of the level of knowledge of the master's student is carried out on a ten-point scale in accordance with the criteria approved by the Ministry of Education of the Republic of Belarus.

To assess the achievements of the master's student, it is recommended to use the following diagnostic tools:

- oral survey during classes;
- computer testing;
- abstracts.

Guidelines for organizing and implementing guided independent work for master's students

When studying the discipline, it is recommended to use the following forms of independent work:

- independent work in the form of discussing reports in the classroom during practical classes under the supervision of a teacher in accordance with the schedule,
- learning using educational literature.

Recommended List of abstracts

1. Modern content of management decision-making processes, characteristics and features.

2. Integration of management theory and decision-making theory.

3. Universal decision-making theory in light of transformations of modern management concepts.

4. The decisive role of creativity and innovation in creating competitive advantages; managing creativity to find non-standard, creative, unique solutions for business development.

5. Modern methods and methodologies for managing innovative thinking.

6. Reducing the complexity of the decision-making process: necessity, main forms and problems.

7. Formulating norms of behavior as a decision-making problem: explicit and implicit norms of behavior; standardization and programming.
8. Characteristics and features of object, organizational, communication decisions.
9. The problem of integrating object and organizational decisions; organizational and communication decisions.
10. Possibilities and limitations of decision-making models.
11. Description of uncertainty in decision-making theory. The need to reduce the complexity of the decision-making process.
12. Formation of explicit norms of behavior; basic provisions of team theory.
13. Methods for reducing the complexity of decision-making processes:
14. Creative thinking, methods and techniques for its development. Creative opportunities and barriers.
15. Methods for finding ideas for solving problems in business.
16. The essence of innovations in decision-making theory; Innovative technologies for making creative, non-standard (unique) decisions.
17. Selecting alternatives when solving unstructured problems.
18. Risk: outcome of decision making; payoff matrix; value function; expected utility.
19. Description of uncertainty in decision theory.
20. The essence and content of management decisions. Typology and classification of management decisions.
21. Functions of decisions in the methodology and organization of management processes. Forms of preparation and implementation of management decisions.
22. Scientific approaches to organizing the development and implementation of management decisions. Principles of forming management decisions, developed in the scientific works of Berg A.I., Bogdanov A.A., Gvishiani D.M., Raif Kh., Raif G., Tsygichko, Simon G. and others.
23. Integration of management theory and decision theory. Universal theory of decision making in light of transformations of modern management concepts.
24. The decisive role of creativity and innovation in creating competitive advantages; managing creativity to find non-standard, creative, unique solutions for business development.
25. Modern methods and methodology for managing innovative thinking in decision-making.
26. Decision-making models.
27. The main model of decision-making. Primary and secondary determinants (decision factors).
28. Algorithm for making management decisions. Organization of the process of developing management decisions.
29. Diagnostics and identification of problems (construction of a problem tree).

30. The concept of an alternative in decision-making processes; choice of alternatives; languages for describing alternatives. Criteria and limitations for choosing alternatives.
31. The composition of procedures for developing, coordinating, approving and organizing the implementation of management decisions.
32. The influence of the manager's personality on decision-making, motivating employees to participate in making management decisions.
33. Organization of situational centers.
34. Characteristics, features and interrelation of objective, organizational, communication decisions. The problem of integration of objective and organizational decisions; organizational and communication decisions.
35. Methods and techniques for analyzing alternatives of actions.
36. Formulation of norms of behavior as a problem of decision-making: explicit and implicit norms of behavior; standardization and programming.
37. Creative thinking, methods and techniques of its development. Creative possibilities and barriers of creative thinking.
38. Methods of searching for ideas for solving problems in business. The essence of innovations in the theory of decision-making; innovative technologies for making creative, non-standard (unique) decisions.
39. Techniques of creative thinking in making management decisions.
40. Selection of alternatives when solving unstructured problems.
41. Classification of methods for implementing management decisions. Methods for organizing the implementation of management decisions.
42. Methods of monitoring the implementation of decisions. Organization of monitoring the process of implementing management decisions.
43. Responsibility in the system of development and implementation of management decisions. Types of responsibility.
44. Efficiency of management decisions and its components. Methods for calculating the economic efficiency of preparation and implementation of management decisions.
45. Systems of information and intellectual support for the development and implementation of management decisions

Recommended list of exam questions

1. Specifics of IT projects
2. Priority of innovative activities at the current stage of economic development. Concept of a project.
3. Basic principles of program-target and project-oriented management.
4. Relationship between project management and functional management.
5. Transition to project management: tasks and stages of solution.
6. Classification of basic project management concepts.
7. Classification of project types.
8. Purpose and strategy of projects. Project result.
9. Project parameter management.
10. Project cycle.
11. General characteristics of software projects.
12. Success factors of an IT solution implementation project.
13. Typical errors in IT project management.
14. Project management processes.
15. Maturity levels of project management processes.
16. Key areas of the IT project management process
17. IT product life cycle models.
18. Relationship between the life cycle of an IT solution and the life cycle of a project.
19. Software project management theories.
20. Classification of software development methods, models and standards.
21. Agile rapid adaptive development methodologies (SCRUM, XP, Crystal).
22. Role (organizational) structure of IT project management
23. Organizational structure of project performers. Concept of function, role, position.
24. Contractor-customer relationships.
25. Key roles.
26. Project manager.
27. Initiation of an IT project.
28. Feasibility study (FS) of an IT project.
29. Project significance criteria: financial and strategic value of the project, risk level.
30. Defining project goals and objectives.
31. Formulating the business goal of the project.
32. Benefit structuring matrix.
33. Identifying the project environment: project stakeholders and analyzing their impact on the project.
34. Defining project boundaries.
35. Developing project management baselines. Types of plans and their purpose.
36. Managing the project scope and forming the project work breakdown structure (WBS).

37. Forming the project schedule.
38. Project deadline management.
39. Estimating labor intensity based on labor intensity assessment models.
40. Project resources. Resource allocation patterns.
41. Developing the project schedule. Critical path method.
42. Project cost estimation methods.
43. Identifying and planning project risk management.
44. Concept of project risk, probability of risk occurrence, risk impact assessment, risk magnitude calculation.
45. Risk identification and prioritization methods. Most common IT project risks.
46. Methods of qualitative and quantitative risk analysis. Risk response strategy development.
47. Project execution management and closure.
48. Monitoring and control. Control indicators.
49. Project deadline and schedule management.
50. Project quality management. Error registration and tracking.
51. IT project requirements management. Requirements groups according to the FURPS+ model.
52. Project closure stage and its role in ensuring the maturity of project management processes in the organization.

РЕКОМЕНДУЕМАЯ ЛИТЕРАТУРА

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**ПРОТОКОЛ СОГЛАСОВАНИЯ УЧЕБНОЙ ПРОГРАММЫ
ПО ИЗУЧАЕМОЙ УЧЕБНОЙ ДИСЦИПЛИНЫ
С ДРУГИМИ ДИСЦИПЛИНАМИ СПЕЦИАЛЬНОСТИ**

Название учебной дисциплины с которой требуется согласование	Название кафедры	Предложения об изменениях в содержании учебной программы учреждения высшего образования по учебной дисциплине	Решение, принятое кафедрой, разработавшей учебную программу (с указанием даты и номера протокола)
Commercialization of research results	Фундаментальной и прикладной математики	Нет	Оставить содержание учебной дисциплины без изменения, протокол № 5 от 24.12.2024.