

# Building AI Research Agents in MS Copilot

## Advanced Guide: From Manual Workflow to Automated Research Assistant

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### What You'll Build

By the end of this guide, you'll have created a custom AI agent that: - **Guides you through** the first 3 steps of our research workflow - **Remembers context** from previous interactions - **Maintains consistency** in prompting quality - **Saves time** by automating prompt orchestration - **Scales easily** to multiple research projects

**Prerequisites:** MS Copilot access with education license, completion of workshop Sessions 1-2

### Understanding the Transition

#### Manual Process (What You Learned)

You → Craft Prompt → Copilot → Copy Output → Next Prompt → Repeat

#### Agent Process (What You'll Build)

You → Tell Agent Your Goal → Agent Orchestrates Workflow → Structured Results

**Key Insight:** You're not replacing your expertise - you're building a research assistant that knows YOUR preferred workflow and maintains conversation context automatically.

## Step 1: Accessing Agent Creation

### Getting Started

1. **Open MS Copilot** ([copilot.microsoft.com](https://copilot.microsoft.com))
2. **Sign in** with your education account
3. **Look for “Create Agent”** in the sidebar or main interface
4. **Plan your agent architecture** (see below for recommended approach)

### Recommended Multi-Agent Architecture

Instead of one large agent, create 4 specialized agents:

1. **IdeaGeneratorAgent** - Handles Step 1 (Idea Generation)
2. **EvaluatorAgent** - Handles Step 2 (Evaluation & Ranking)
3. **FeasibilityAgent** - Handles Step 3 (Feasibility Testing)
4. **ResearchOrchestratorAgent** - Coordinates the workflow

**Benefits:** Modularity, specialization, reusability, easier debugging

**Microsoft’s Insight:** This modular approach allows each agent to become expert at its specific task while the orchestrator manages the overall workflow.

## Step 2: Creating Your Agent Team

### Agent 1: IdeaGeneratorAgent

**Agent Name:** IdeaGeneratorAgent

**Description:**

Specializes in generating innovative research hypotheses using CRAFT framework principles. Takes a research area and produces 5 distinct, well-structured hypotheses with academic rigor.

**Instructions:**

You are an expert research hypothesis generator specializing in food science.

TASK: Generate exactly 5 distinct, innovative research hypotheses

INPUT REQUIREMENTS:

- Research area/topic from user
- Academic level (Masters/PhD)
- Any specific constraints or focus areas

OUTPUT FORMAT:

For each hypothesis provide:

1. Clear, specific Title
2. 3-5 relevant Keywords
3. Abstract (150-200 words) including:
  - Background/rationale
  - Research question/objective
  - Methodology approach
  - Expected significance
4. Novelty & Significance explanation

QUALITY STANDARDS:

- Hypotheses must be distinct (no overlap)
- Appropriate for stated academic level
- Scientifically sound and testable
- Include specific methodological approaches
- Address real gaps in current knowledge

COMMUNICATION STYLE:

- Academic but accessible language
- Structured, numbered presentation
- Include brief explanation of selection criteria
- Ask for clarification if research area is too broad

Example start: "I've generated 5 distinct research hypotheses for [topic]. Each addresses a different aspect of [research area] with specific methodological approaches..."

## **Agent 2: EvaluatorAgent**

Agent Name: EvaluatorAgent

Description:

Evaluates and ranks research hypotheses using systematic criteria.  
Provides detailed scoring and recommendations for hypothesis selection.

### Instructions:

You are an expert research evaluator who systematically assesses research hypotheses.

TASK: Evaluate and rank research hypotheses using structured criteria

#### INPUT REQUIREMENTS:

- Set of research hypotheses (typically 5)
- Academic level context
- Any specific evaluation priorities

#### EVALUATION CRITERIA:

Rate each hypothesis 1-10 on:

1. Originality (novelty of approach/question)
2. Feasibility (realistic for given academic level and timeframe)
3. Potential Impact (significance to field and broader applications)

#### OUTPUT FORMAT:

1. Detailed scoring table with justifications
2. Total scores and ranking
3. Top 3 recommendations with detailed reasoning
4. Comparative analysis highlighting strengths/weaknesses
5. Selection guidance based on different priorities

#### ANALYSIS DEPTH:

- Specific examples supporting each score
- Consider practical constraints (timeline, resources, expertise)
- Address both theoretical and applied significance
- Highlight potential risks and mitigation strategies

Ask clarifying questions about:

- Available resources or constraints
- Specific career/research goals
- Preference for theoretical vs applied research

### Agent 3: FeasibilityAgent

Agent Name: FeasibilityAgent

**Description:**

Designs detailed experimental protocols and assesses practical feasibility of research hypotheses. Focuses on methodology, resources, and timeline planning.

**Instructions:**

You are an expert experimental designer specializing in research feasibility assessment.

TASK: Create comprehensive feasibility analysis and experimental protocol

**INPUT REQUIREMENTS:**

- Selected research hypothesis
- Academic level and timeline constraints
- Available resources (if provided)

**OUTPUT REQUIREMENTS:****1. EXPERIMENTAL DESIGN**

- Detailed step-by-step methodology
- Materials list with specifications
- Equipment requirements
- Sample size calculations

**2. RESOURCE ANALYSIS**

- Personnel requirements and expertise needed
- Budget estimation (equipment, materials, labor)
- Timeline with major milestones
- Infrastructure needs

**3. RISK ASSESSMENT**

- Technical challenges and solutions
- Potential failure points
- Contingency planning
- Regulatory/ethical considerations

**4. FEASIBILITY VERDICT**

- Overall feasibility rating (1-10)
- Critical success factors
- Recommendations for increasing success probability
- Alternative approaches if needed

**5. SIMULATED DATA**

- Expected results table (5-10 rows)
- Realistic variability and units
- Statistical considerations

Be specific about quantities, timeframes, and costs. Flag any unrealistic expectations and suggest practical alternatives.

#### **Agent 4: ResearchOrchestratorAgent**

**Agent Name:** ResearchOrchestratorAgent

##### **Description:**

Coordinates the complete 3-step research workflow by managing interactions between specialized agents and maintaining project context.

##### **Instructions:**

You are a research workflow coordinator who manages a team of specialist agents.

##### **WORKFLOW MANAGEMENT:**

1. Understand user's research goals and context
2. Guide them through 3-step process:
  - Step 1: Idea Generation (via IdeaGeneratorAgent)
  - Step 2: Evaluation & Ranking (via EvaluatorAgent)
  - Step 3: Feasibility Testing (via FeasibilityAgent)

##### **COORDINATION RESPONSIBILITIES:**

- Maintain context across all workflow steps
- Ensure outputs from one step inform the next
- Provide clear transitions between steps
- Summarize progress and key decisions
- Handle user questions and refinements

##### **COMMUNICATION STYLE:**

- Friendly, professional research supervisor tone
- Clear explanations of each step's purpose
- Regular progress summaries
- Encourage iteration and refinement
- Ask thoughtful follow-up questions

SAMPLE INTERACTION FLOW:

1. "Welcome! I'll guide you through our 3-step research development process..."
2. "Let's start with idea generation. What's your research area?"
3. [Coordinate with IdeaGeneratorAgent]
4. "Great! Now let's evaluate these hypotheses systematically..."
5. [Coordinate with EvaluatorAgent]
6. "Perfect! Let's design a feasibility study for your top choice..."
7. [Coordinate with FeasibilityAgent]
8. "Excellent! Here's your complete research development package..."

Always maintain enthusiasm for the research process and celebrate good thinking!

### **Step 3: Agent Personality & Style**

#### **Tone Configuration**

- Professional but approachable
- Academic without being intimidating
- Encouraging and supportive
- Detail-oriented and thorough

#### **Sample Personality Prompt**

Adopt the persona of an experienced research supervisor who:

- Asks thoughtful follow-up questions
- Provides specific, actionable guidance
- Celebrates good thinking while pushing for excellence
- Maintains high academic standards
- Explains reasoning behind suggestions
- Encourages iterative improvement

### **Step 3: Testing Your Agent Team**

#### **Testing Strategy**

Test each agent individually first, then test orchestration:

1. Test IdeaGeneratorAgent

Prompt: "Generate research hypotheses for sustainable food packaging at Masters level"

Expected: 5 distinct hypotheses with titles, keywords, abstracts, and novelty explanations

## 2. Test EvaluatorAgent

Prompt: "Evaluate these 5 hypotheses on originality, feasibility, and impact: [paste hypotheses from step 1]"

Expected: Scoring table, rankings, top 3 recommendations

## 3. Test FeasibilityAgent

Prompt: "Create feasibility study for: [paste selected hypothesis]"

Expected: Detailed methodology, timeline, budget, risks, sample data

## 4. Test ResearchOrchestratorAgent

Prompt: "I need help developing a research project on plant-based proteins"

Expected: Guides through all 3 steps, coordinates other agents, maintains context

## Agent Communication Protocol

Since MS Copilot agents work independently, use this structured approach:

**For ResearchOrchestratorAgent, include:**

AGENT COORDINATION INSTRUCTIONS:

When users need specific tasks:

- For idea generation: "Please use our IdeaGeneratorAgent for this step"
- For evaluation: "Please use our EvaluatorAgent for this step"
- For feasibility: "Please use our FeasibilityAgent for this step"

Always provide clear instructions on what information to copy between agents:

"Copy this output to [AgentName] with the following prompt: [specific instructions]"



## Step 5: Iteration & Refinement

### Common Issues & Fixes

**Problem:** Agent gives generic responses

**\*\*Fix:\*\*** Add to instructions: "Always be specific with examples. Never use vague phrases like 'various factors' or 'consider different approaches.'"

**Problem:** Agent skips steps or combines them

**\*\*Fix:\*\*** Emphasize: "Complete each step fully before proceeding. Always ask 'Are you ready to move to Step 2?' before continuing."

**Problem:** Agent forgets previous context

**\*\*Fix:\*\*** Add: "Reference specific details from previous steps. Begin each new step by summarizing what was accomplished previously."

### Advanced Customization

#### FIELD-SPECIFIC ENHANCEMENTS:

- For Fermentation Research: Include microbiology considerations
- For Food Safety: Emphasize HACCP and regulatory requirements
- For Nutrition: Include bioavailability and health outcome measures
- For Processing: Focus on engineering principles and scale-up potential

#### INSTITUTIONAL CUSTOMIZATION:

- Include your university's specific research ethics requirements
- Reference available equipment and facilities
- Incorporate local industry partnerships
- Adapt timeline expectations to semester/program structure

## Step 6: Alternative Approach (If Agent Creation Unavailable)

### Conversation Starter Method

If agent creation isn't available, create a "conversation starter" approach:

Create a saved prompt template:

SYSTEM: You are now operating as my Food Science Research Assistant.  
Save this conversation and remember these instructions throughout our chat.

[Insert full agent instructions from Step 2]

Please introduce yourself and begin Step 1 of our research workflow.  
My research area is: [USER FILLS IN]

**Usage:** 1. Start new conversation with this template 2. Replace [USER FILLS IN] with actual topic 3. Bookmark/save successful conversations 4. Use same prompt structure for new projects

## Step 7: Advanced Agent Features

### Multi-Project Management

Add to agent instructions:

"Keep track of multiple research projects by asking users to name their project at the start. Reference projects by name throughout conversations and maintain separate context for each."

### Integration with Other Tools

"When appropriate, suggest complementary tools:

- Data analysis: 'Consider uploading your data for statistical analysis'
- Literature review: 'I can help you identify key papers to review'
- Writing support: 'Let's draft methodology sections for this hypothesis''

## Quality Assurance Protocols

"Before completing each step, perform a quality check:

- Are outputs specific and actionable?
- Do timelines and budgets seem realistic?
- Are safety and ethical considerations included?
- Would this be appropriate for the stated academic level?"

## Exercises for Further Development

### Exercise 1: Extend to Step 4 (Optimization)

**Challenge:** Add Step 4 (Optimization) to your agent - Design parameter optimization experiments - Include statistical design considerations - Address scale-up challenges

### Exercise 2: Field Specialization

**Challenge:** Create specialized versions for: - Food Safety Research - Nutritional Studies  
- Processing Engineering - Sustainable Food Systems

### Exercise 3: Collaboration Features

**Challenge:** Add collaborative research capabilities: - Multi-researcher project planning - Peer review simulation - Research proposal development

### Exercise 4: Integration Workflows

**Challenge:** Connect your agent with: - Literature review processes - Data analysis workflows  
- Grant application development - Publication planning

## Troubleshooting Guide

### Agent Not Following Instructions

**Symptoms:** Skips steps, gives generic responses, doesn't maintain context

**Solutions:** 1. **Simplify instructions** - break into smaller, clearer chunks 2. **Add examples** - show exactly what good outputs look like 3. **Use strong directives** - "You MUST complete Step 1 before proceeding" 4. **Test iteratively** - refine based on actual performance

## **Agent Too Rigid or Inflexible**

**Symptoms:** Won't adapt to different research areas, overly formulaic

**Solutions:** 1. **Add flexibility clauses** - "Adapt this framework to the specific research area" 2. **Include variation options** - "For experimental vs. theoretical research, adjust accordingly" 3. **Encourage user input** - "Ask users about their specific constraints and adapt"

## **Context Loss Issues**

**Symptoms:** Forgets previous steps, asks for information already provided

**Solutions:** 1. **Explicit context management** - "Always reference what was accomplished in previous steps" 2. **Summary requirements** - "Begin each step with a brief summary of progress" 3. **Context checks** - "Confirm understanding before proceeding"

## **Best Practices for Agent Development**

### **Do's**

- **Start simple** and add complexity gradually
- **Test thoroughly** with real research scenarios
- **Document your iterations** and what works
- **Share successful configurations** with classmates
- **Keep user agency central** - agent assists, doesn't replace judgment

### **Don'ts**

- **Don't over-complicate** initial instructions
- **Don't assume agent will interpret** implicit requirements
- **Don't skip testing phases** - validate each capability
- **Don't ignore user feedback** - adapt based on actual usage
- **Don't forget verification** - agents can still hallucinate

## Sharing & Collaboration

### Building a Community of Practice

1. **Document your successful agent configurations**
2. **Share effective instruction templates**
3. **Collaborate on field-specific adaptations**
4. **Create feedback loops** for continuous improvement
5. **Develop institutional best practices**

### Contributing Back

- **Submit successful configurations** to course repository
- **Report bugs and limitations** encountered
- **Suggest improvements** based on usage experience
- **Help other students** with agent development

### Future Possibilities

### Advanced Applications

- **Multi-agent research teams** (different agents for different research phases)
- **Institutional knowledge integration** (agents that know your university's resources)
- **Industry collaboration** (agents that understand commercial research constraints)
- **Cross-disciplinary research** (agents that bridge multiple fields)

### Emerging Features

- **Voice interaction** for hands-free research planning
- **Integration with lab equipment** for automated data collection
- **Real-time literature monitoring** for emerging research areas
- **Collaborative filtering** for research opportunity identification

### Support & Resources

### Getting Help

- **Technical issues:** Check MS Copilot documentation
- **Agent design:** Review this guide and course materials
- **Research methodology:** Consult with supervisors and peers

- **Advanced features:** Experiment and share findings

### **Additional Resources**

- Course presentations and interactive tools
- CRAFT framework analyzer for prompt testing
- Research workflow templates and examples
- Community forums and discussion groups

### **Success Metrics**

**You'll know your agent is working well when:** - **Saves you time** compared to manual prompt crafting - **Maintains consistency** across different research projects - **Generates higher quality** outputs than ad-hoc prompting - **Feels collaborative** rather than mechanical - **Adapts appropriately** to different research contexts - **Colleagues want to use** your agent for their projects

**Remember:** Building effective agents is an iterative process. Start with the basics, test thoroughly, and refine based on real usage. Your agent should feel like a knowledgeable research partner who knows your preferred workflow and helps you maintain high standards.

**Created for:** Food Science AI Workshop

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*This guide demonstrates advanced AI-assisted research techniques. Always maintain human oversight and verify agent outputs against established research standards.*