🤖 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)
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

1. **Test EvaluatorAgent**

* Prompt: "Evaluate these 5 hypotheses on originality, feasibility,   
  and impact: [paste hypotheses from step 1]"  
    
  Expected: Scoring table, rankings, top 3 recommendations

1. **Test FeasibilityAgent**

* Prompt: "Create feasibility study for: [paste selected hypothesis]"  
    
  Expected: Detailed methodology, timeline, budget, risks, sample data

1. **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.*