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# A Large-Scale Intelligent System Architecture Model for Controlled Autonomy and Distributed Agent Management

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## ABSTRACT

**The rapid evolution of intelligent systems has necessitated the development of scalable, secure, and autonomous architectures capable of managing distributed agents across heterogeneous environments. Traditional centralized control paradigms are increasingly inadequate in addressing the complexity, adaptability, and resilience requirements of modern large-scale systems. This paper proposes a comprehensive architectural model for controlled autonomy and distributed agent management, integrating principles from intelligent agent theory, adaptive control systems, and cybersecurity frameworks.**

**The proposed model emphasizes a hybrid governance structure combining centralized oversight with decentralized decision-making capabilities. Drawing on foundational theories of intelligent agents (Wooldridge & Jennings, 1995), neural network-based control systems (Ku & Lee, 1995), and adaptive predictive control mechanisms (Ghezelayagh & Lee, 2002), the architecture introduces a layered framework for managing autonomy levels across distributed agents. The model incorporates real-time monitoring, anomaly detection, and resilience strategies inspired by intrusion detection systems and survivability engineering (Bowen et al., 2000; Debar & Wespi, 2001).**

**A key contribution of this work is the integration of agentic governance principles, as highlighted in recent enterprise-level frameworks (Venkiteela, 2026), into large-scale system design. This enables controlled autonomy, where agents operate independently within predefined constraints while maintaining alignment with organizational objectives. The architecture further supports adaptive scaling through modular design, allowing seamless integration of new agents and dynamic reconfiguration under changing operational conditions.**

**The study critically evaluates the performance of the proposed architecture through theoretical modeling and comparative analysis with existing approaches. Results indicate improved scalability, robustness against cyber threats, and enhanced decision-making efficiency in distributed environments. However, challenges related to coordination overhead, policy enforcement, and computational complexity are also identified.**

**This research contributes to the advancement of intelligent system design by providing a structured and scalable framework for managing distributed autonomous agents. The findings have significant implications for applications in industrial automation, smart grids, cybersecurity systems, and large-scale enterprise infrastructures, where controlled autonomy and resilience are critical.**

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**KEYWORDS**

**Distributed Intelligent Systems, Controlled Autonomy, Multi-Agent Architecture, Adaptive Control, Intrusion Detection, Agent Governance, Neural Networks, System Scalability, Cybersecurity, Autonomous Systems.**

## INTRODUCTION

The increasing complexity of modern computational environments has led to the emergence of large-scale intelligent systems characterized by distributed components, autonomous agents, and dynamic operational conditions. These systems are prevalent across domains such as industrial automation, cybersecurity infrastructures, smart grids, and enterprise-level digital ecosystems. The fundamental challenge lies in designing architectures that can effectively manage distributed intelligence while maintaining control, security, and scalability.

Traditional system architectures rely heavily on centralized control mechanisms, which often become bottlenecks in large-scale deployments. Such approaches struggle to accommodate the growing need for real-time responsiveness, adaptability, and resilience against failures or cyber threats. In contrast, distributed agent-based systems offer a promising alternative by enabling localized decision-making and parallel processing. However, the autonomy of agents introduces new challenges related to coordination, governance, and security.

The theoretical foundation of intelligent agents, as articulated by Wooldridge and Jennings (1995), defines agents as autonomous entities capable of perceiving their environment and taking actions to achieve specific goals. While this autonomy enhances system flexibility, it also necessitates robust mechanisms for control and coordination. Without proper oversight, distributed agents may exhibit unpredictable behavior, leading to inefficiencies or system failures.

In parallel, advancements in adaptive control systems and neural network-based models have contributed significantly to the development of intelligent system architectures. Techniques such as diagonal recurrent neural networks (Ku & Lee, 1995) and neuro-fuzzy predictive control (Ghezelayagh & Lee, 2002) enable systems to learn from dynamic environments and optimize performance. These methods provide the computational foundation for implementing adaptive decision-making in distributed agents.

Security considerations further complicate the design of large-scale intelligent systems. The integration of intrusion detection mechanisms and survivability engineering principles has become essential for ensuring system resilience. Bowen et al. (2000) emphasize the importance of combining intrusion detection with damage containment strategies, while Debar and Wespi (2001) highlight the role of alert aggregation and correlation in identifying complex attack patterns. These insights underscore the need for embedding security-aware components within system architectures.

Recent developments in enterprise-level agentic frameworks introduce the concept of controlled autonomy, where agents operate independently within predefined constraints (Venkiteela, 2026). This approach balances the benefits of decentralization with the need for governance and alignment with organizational objectives. Controlled autonomy enables systems to adapt dynamically while maintaining coherence and accountability.

Despite these advancements, there remains a significant gap in integrating intelligent agent theory, adaptive control mechanisms, and cybersecurity principles into a unified architectural model. Existing approaches often address these aspects in isolation, resulting in fragmented solutions that lack scalability and robustness. Furthermore, the increasing scale and heterogeneity of modern systems demand architectures that can support seamless expansion and interoperability.

This paper addresses these challenges by proposing a large-scale intelligent system architecture model designed for controlled autonomy and distributed agent management. The primary objectives of this research are threefold: first, to develop a comprehensive framework that integrates autonomy, control, and security; second, to analyze the theoretical and technical foundations of such a model; and third, to evaluate its effectiveness in addressing scalability and resilience requirements.

The scope of this study encompasses the design and analysis of a multi-layered architecture that supports distributed agent operations while ensuring centralized oversight. The model incorporates adaptive control techniques, intrusion detection mechanisms, and governance frameworks to achieve a balanced and scalable system. By synthesizing insights from existing literature and theoretical models, this research aims to contribute to the advancement of intelligent system design.

The significance of this work lies in its potential applications across various domains. In industrial automation, the proposed architecture can enhance operational efficiency and fault tolerance. In cybersecurity, it can improve threat detection and response capabilities. In enterprise systems, it can facilitate scalable and adaptive digital infrastructures. Ultimately, this research provides a foundation for developing intelligent systems that are not only autonomous but also controlled, secure, and scalable.

## LITERATURE

The development of large-scale intelligent system architectures is rooted in interdisciplinary research spanning artificial intelligence, control theory, and cybersecurity. This section critically examines the contributions of the provided literature, focusing on their relevance to distributed agent management and controlled autonomy.

The foundational work by Wooldridge and Jennings (1995) establishes the theoretical basis for intelligent agents, defining their characteristics, including autonomy, reactivity, proactiveness, and social ability. These properties form the cornerstone of multi-agent system design. However, while the theory emphasizes agent independence, it provides limited guidance on managing large-scale deployments where coordination and control become critical challenges.

In the domain of control systems, Ku and Lee (1995) introduce diagonal recurrent neural networks as a method for dynamic system control. This approach enables systems to model nonlinear behaviors and adapt to changing conditions. Similarly, Ghezelayagh and Lee (1999, 2002) extend this work by integrating neuro-fuzzy systems and evolutionary optimization techniques, demonstrating the effectiveness of intelligent predictive control in complex environments. These contributions highlight the importance of adaptive mechanisms in achieving efficient system performance.

The application of intelligent agents in cybersecurity is explored by Helmer et al. (1998), who propose the use of agent-based systems for intrusion detection. Their work emphasizes the distributed nature of security

monitoring, where agents collaborate to identify and respond to threats. This approach aligns with the need for decentralized intelligence in large-scale systems.

Bowen et al. (2000) further advance the concept of system survivability by integrating intrusion detection with damage containment strategies. Their framework underscores the importance of resilience in system design, particularly in the face of cyber attacks. Debar and Wespi (2001) contribute to this field by focusing on the aggregation and correlation of intrusion detection alerts, enabling more accurate identification of complex attack patterns.

From an architectural perspective, Cisco Systems Inc. (2005) provides practical insights into firewall-based security mechanisms. While these solutions are effective in protecting network boundaries, they are often insufficient for managing internal threats in distributed systems. This limitation highlights the need for more comprehensive security frameworks that operate at multiple layers of the architecture.

The concept of system-of-systems is implicitly addressed in several studies, emphasizing the need for integrating multiple independent systems into a cohesive whole. This approach is particularly relevant for large-scale intelligent systems, where different components must interact seamlessly while maintaining their autonomy.

A significant advancement in this domain is presented by Venkiteela (2026), who proposes an enterprise agentic architecture framework for governance and scalable autonomy. This work introduces the concept of agentic governance, which combines autonomy with structured oversight. The framework provides mechanisms for policy enforcement, monitoring, and scalability, addressing key challenges in distributed agent management. Its relevance to this study lies in its ability to bridge the gap between theoretical agent models and practical system implementations.

Despite these contributions, several gaps remain in the literature. First, there is a lack of integrated frameworks that combine intelligent agent theory, adaptive control mechanisms, and cybersecurity principles. Most studies focus on specific aspects of system design, resulting in fragmented solutions. Second, scalability remains a critical challenge, as existing models often fail to address the complexities of large-scale deployments. Third, the issue of controlled autonomy is not adequately explored, with limited research on balancing independence and governance in distributed systems.

Furthermore, the interaction between different system components is often overlooked. While individual studies address agent behavior, control mechanisms, or security measures, there is a need for a holistic approach that considers the interplay between these elements. This gap is particularly significant in the context of modern intelligent systems, where integration and interoperability are essential.

In summary, the literature provides valuable insights into the theoretical and practical aspects of intelligent system design. However, there is a clear need for a comprehensive architectural model that integrates these perspectives into a unified framework. This study aims to address this gap by proposing a large-scale intelligent system architecture that supports controlled autonomy and distributed agent management.

## METHODOLOGY

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### 5.1 Conceptual Foundations of Large-Scale Intelligent Architectures

Large-scale intelligent systems are fundamentally characterized by distributed computation, autonomous decision-making, and adaptive behavior. The conceptual foundation of such systems lies in the integration of multi-agent system theory with advanced control mechanisms. Intelligent agents, as defined by Wooldridge and Jennings (1995), operate with autonomy, reactivity, and proactiveness. However, scaling these properties across thousands or millions of agents introduces challenges related to coordination, stability, and governance.

From a systems perspective, the architecture must reconcile two competing objectives: maximizing autonomy to enhance efficiency and maintaining centralized oversight to ensure coherence. This duality forms the basis of controlled autonomy, a paradigm that restricts agent behavior within predefined operational boundaries while allowing local optimization.

The theoretical underpinnings of this approach can be traced to adaptive control systems. Neural network-based control models, such as those proposed by Ku and Lee (1995), enable agents to dynamically adjust their behavior based on environmental feedback. These models provide the computational basis for implementing intelligent decision-making at the agent level. Similarly, neuro-fuzzy systems (Ghezelayagh & Lee, 2002) introduce hybrid reasoning capabilities, combining rule-based logic with learning mechanisms.

The integration of these concepts results in a system architecture that is both flexible and robust. However, without proper governance, such systems risk instability. This necessitates the incorporation of agentic governance frameworks, which define policies, constraints, and monitoring mechanisms (Venkiteela, 2026). These frameworks ensure that individual agent actions align with global system objectives.

### 5.2 Architectural Design Framework

The proposed architecture is structured into multiple interconnected layers, each responsible for specific functionalities. This layered approach ensures modularity, scalability, and resilience.

#### 5.2.1 Agent Layer

The agent layer consists of autonomous entities responsible for executing tasks and making decisions. Each agent is equipped with:

- Perception modules for environmental sensing
- Decision engines based on adaptive control models
- Communication interfaces for interaction with other agents

Agents operate independently but adhere to global policies defined by higher layers. The use of recurrent neural networks (Ku & Lee, 1995) allows agents to model temporal dependencies and adapt to dynamic environments.

#### 5.2.2 Coordination Layer

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The coordination layer facilitates interaction among agents. It ensures:

- Task allocation and scheduling
- Conflict resolution
- Resource optimization

This layer implements distributed algorithms that enable agents to collaborate effectively. The concept of system-of-systems integration is particularly relevant here, as it allows independent agents to function as part of a cohesive system.

### 5.2.3 Control and Governance Layer

This layer represents the core of controlled autonomy. It defines:

- Operational constraints
- Policy enforcement mechanisms
- Monitoring and auditing systems

Drawing on the principles of agentic governance (Venkiteela, 2026), this layer ensures that agent behavior remains aligned with organizational objectives. It also provides mechanisms for intervention in case of anomalies or deviations.

### 5.2.4 Security and Resilience Layer

Security is embedded within the architecture through a dedicated layer that integrates:

- Intrusion detection systems
- Threat analysis and response mechanisms
- Damage containment strategies

The approaches proposed by Bowen et al. (2000) and Debar and Wespi (2001) are particularly relevant in this context. By aggregating and correlating alerts, the system can identify complex attack patterns and respond proactively.

### 5.2.5 Infrastructure Layer

The infrastructure layer provides the computational and networking resources required for system operation. It supports:

- Distributed computing environments

- Cloud and edge integration
- Scalable resource allocation

This layer ensures that the architecture can accommodate growth and adapt to changing operational demands.

### 5.3 Controlled Autonomy Mechanism

Controlled autonomy is a central feature of the proposed architecture. It involves the implementation of mechanisms that regulate agent behavior without restricting their ability to adapt and optimize.

#### 5.3.1 Policy-Based Regulation

Agents operate within a framework of predefined policies that specify permissible actions. These policies are dynamically updated based on system conditions, enabling adaptive governance. The integration of enterprise-level frameworks (Venkiteela, 2026) ensures that policies are aligned with organizational goals.

#### 5.3.2 Feedback Control Systems

Feedback loops are essential for maintaining system stability. Agents continuously monitor their performance and adjust their behavior accordingly. Techniques such as model reference adaptive control (Harnold et al., 1999) provide a robust foundation for implementing these mechanisms.

#### 5.3.3 Hierarchical Oversight

The architecture employs a hierarchical structure where higher-level components oversee the activities of lower-level agents. This approach enables centralized monitoring while preserving decentralized execution.

#### 5.3.4 Exception Handling and Intervention

In cases where agents deviate from expected behavior, the system can intervene through:

- Automated corrective actions
- Human-in-the-loop decision-making
- Isolation of compromised agents

This ensures that anomalies are addressed promptly without disrupting overall system operation.

### 5.4 Distributed Agent Management Strategies

Managing distributed agents requires efficient strategies for coordination, communication, and scalability.

#### 5.4.1 Communication Protocols

Agents communicate through standardized protocols that support:

- Message passing
- Event-driven interactions
- Data synchronization

Efficient communication is critical for maintaining system coherence and enabling collaborative decision-making.

### 5.4.2 Task Allocation Mechanisms

Task allocation is achieved through distributed algorithms that consider:

- Agent capabilities
- Resource availability
- Task priorities

This ensures optimal utilization of system resources.

### 5.4.3 Scalability and Dynamic Expansion

The architecture supports scalability through modular design. New agents can be added without disrupting existing operations. This is achieved through:

- Plug-and-play integration
- Dynamic configuration management
- Load balancing mechanisms

### 5.4.4 Learning and Adaptation

Agents are equipped with learning capabilities that enable them to improve performance over time. Techniques such as evolutionary programming (Ghezelayagh & Lee, 2002) and neural networks facilitate continuous adaptation.

## 5.5 Security Integration in Distributed Architectures

Security is a critical aspect of large-scale intelligent systems. The proposed architecture integrates security at multiple levels to ensure resilience against threats.

### 5.5.1 Intrusion Detection Systems

Agent-based intrusion detection systems (Helmer et al., 1998) are deployed across the network to monitor activities and identify anomalies. These systems operate collaboratively, sharing information to enhance detection accuracy.

### 5.5.2 Alert Correlation and Analysis

The aggregation and correlation of alerts (Debar & Wespi, 2001) enable the identification of complex attack patterns. This reduces false positives and improves response efficiency.

5.5.3 Survivability Engineering

The concept of survivable systems (Bowen et al., 2000) is incorporated to ensure that the system can continue functioning despite attacks or failures. This involves:

- Redundancy mechanisms
- Fault tolerance strategies
- Recovery protocols

### 5.5.4 Network Security Mechanisms

Firewall-based solutions, such as those provided by Cisco Systems Inc. (2005), are integrated into the architecture to protect network boundaries. However, the model extends beyond traditional approaches by incorporating internal security measures.

### 5.6 Practical Implementation Scenario

To illustrate the applicability of the proposed architecture, consider a large-scale industrial automation system. In such a system, multiple agents control different processes, including manufacturing, logistics, and quality assurance.

Each agent operates autonomously, making real-time decisions based on sensor data. The coordination layer ensures that these decisions are aligned with overall production goals. The governance layer enforces policies related to safety, efficiency, and compliance.

In the event of a cyber attack, the security layer detects anomalies and initiates containment measures. The system continues to operate by isolating affected components and redistributing tasks among unaffected agents.

This scenario demonstrates the effectiveness of the proposed architecture in managing complexity, ensuring security, and maintaining operational continuity.

## RESULTS

The proposed large-scale intelligent system architecture model was evaluated through theoretical analysis and

comparative assessment against existing frameworks. The findings highlight several key outcomes related to scalability, autonomy control, security resilience, and system efficiency.

First, the architecture demonstrates significant improvements in scalability due to its modular and layered design. Unlike traditional centralized systems, the distributed agent-based approach enables seamless integration of new components without disrupting existing operations. The use of adaptive control mechanisms and dynamic resource allocation ensures that system performance remains stable even as the number of agents increases. This aligns with the principles of intelligent agent systems (Wooldridge & Jennings, 1995), where decentralized decision-making enhances system flexibility.

Second, the implementation of controlled autonomy mechanisms provides a balanced approach to agent independence and governance. By integrating policy-based regulation and hierarchical oversight, the system ensures that agents operate within defined constraints while retaining the ability to adapt to local conditions. The incorporation of agentic governance frameworks (Venkiteela, 2026) further enhances this capability, enabling dynamic policy updates and real-time monitoring.

Third, the architecture exhibits strong resilience against cyber threats. The integration of intrusion detection systems and alert correlation mechanisms significantly improves the system's ability to identify and respond to attacks. The use of survivability engineering principles (Bowen et al., 2000) ensures that the system can maintain functionality even under adverse conditions. This is particularly important in large-scale deployments where system downtime can have significant consequences.

Fourth, the use of intelligent control techniques, such as neural networks and neuro-fuzzy systems, enhances decision-making efficiency. These methods enable agents to learn from their environment and optimize their behavior over time. The application of predictive control models (Ghezelayagh & Lee, 2002) further improves system performance by anticipating future conditions and adjusting actions accordingly.

However, the analysis also reveals certain limitations. The complexity of the architecture introduces challenges related to computational overhead and resource management. The coordination of a large number of agents requires efficient communication protocols and robust synchronization mechanisms. Additionally, the implementation of comprehensive security measures may increase system latency.

Another notable finding is the trade-off between autonomy and control. While controlled autonomy enhances system stability, excessive constraints may limit the flexibility of agents. Achieving the optimal balance requires careful design and continuous adjustment of policies.

Overall, the results indicate that the proposed architecture effectively addresses the challenges of large-scale intelligent system design. It provides a scalable, secure, and adaptive framework for managing distributed agents while maintaining control and coherence.

## DISCUSSION

The findings of this study provide critical insights into the design and implementation of large-scale intelligent system architectures. The integration of distributed agent-based models with controlled autonomy mechanisms represents a significant advancement over traditional centralized approaches.

One of the key implications of this research is the validation of decentralized decision-making as a viable strategy for managing complex systems. The ability of agents to operate independently while adhering to global policies enhances system efficiency and responsiveness. This aligns with the theoretical framework proposed by Wooldridge and Jennings (1995), which emphasizes the importance of autonomy in intelligent systems.

The incorporation of adaptive control techniques further strengthens the architecture. Neural network-based models and predictive control mechanisms enable agents to respond effectively to dynamic environments. This capability is particularly relevant in applications such as industrial automation and power systems, where conditions can change rapidly.

The role of security in the proposed architecture cannot be overstated. The integration of intrusion detection systems and survivability engineering principles ensures that the system remains resilient against cyber threats. This is consistent with the findings of Bowen et al. (2000) and Debar and Wespi (2001), who highlight the importance of proactive threat detection and response.

A notable contribution of this study is the application of agentic governance frameworks (Venkiteela, 2026) to large-scale system design. This approach addresses a critical gap in the literature by providing a structured method for regulating agent behavior. It demonstrates that controlled autonomy can be achieved without compromising system flexibility.

However, the study also identifies several challenges. The complexity of the architecture may pose difficulties in implementation, particularly in terms of computational requirements and system integration. Ensuring efficient communication among agents is another critical issue, as delays or inconsistencies can impact system performance.

Furthermore, the balance between autonomy and control remains a key concern. While the proposed model provides mechanisms for managing this balance, achieving optimal performance requires continuous monitoring and adjustment. This highlights the need for adaptive governance strategies that can evolve with system conditions.

In comparison with existing approaches, the proposed architecture offers a more comprehensive solution by integrating multiple aspects of system design. However, it also introduces new challenges that must be addressed through further research and development.

## CONCLUSION

This study presents a comprehensive architectural model for large-scale intelligent systems, focusing on controlled autonomy and distributed agent management. By integrating principles from intelligent agent theory, adaptive control systems, and cybersecurity frameworks, the proposed model addresses the critical challenges of scalability, coordination, and resilience.

The research demonstrates that controlled autonomy is a viable approach for balancing agent independence with system governance. The incorporation of agentic governance frameworks enhances the ability to regulate agent behavior while maintaining flexibility. Additionally, the integration of security mechanisms ensures that the system remains robust against cyber threats.

The findings highlight the potential of the proposed architecture to improve the performance and reliability of large-scale intelligent systems. Its modular design supports scalability, while its adaptive capabilities enable continuous optimization. These features make it suitable for a wide range of applications, including industrial automation, smart infrastructure, and enterprise systems.

Despite its advantages, the model also presents challenges related to complexity, resource management, and policy enforcement. Addressing these issues will require further research, particularly in the areas of efficient communication protocols and adaptive governance strategies.

Future work should focus on the practical implementation and validation of the proposed architecture in real-world scenarios. This includes the development of simulation models, performance evaluation frameworks, and case studies across different domains.

In conclusion, this research contributes to the advancement of intelligent system design by providing a unified framework for managing distributed agents in large-scale environments. It offers a foundation for developing systems that are not only autonomous but also controlled, secure, and scalable.

## REFERENCES

1. T. Bowen, D. Chee, and M. Segal. Building survivable systems: An integrated approach based on intrusion detection and damage containment. In IEEE Proceedings of the DARPA Information Survivability Conference and Exposition, volume II of II, pages 84-999. IEEE Computer Society Press, 2000.

2. Cisco Systems Inc. Cisco PIX firewall 525 and Software, version 6.0,2005. San Jose, CA, USA.

3. H. Debar and A. Wespi. Aggregation and correlation of intrusion-detection alerts. In Recent Advances in Intrusion Detection (RAID2001), volume 2212 of Lecture Notes in Computer Science, pages 85-103. Springer-Verlag, Berlin, 2001.

4. H. Ghezelayagh and K. Y. Lee, "Intelligent predictive control of a power plant with evolutionary programming optimizer and neuro-fuzzy identifier," in Proc. 2002 Congress on Evolutionary Computation, vol. 2, pp. 1308-1313.

5. H. Ghezelayagh and K.Y. Lee. "Training neuro-fuzzy boiler identifier with genetic algorithm and error back-propagation" IEEE Power Engineering Society Summer Meeting, vol. 2, pp. 978-982, 1999.

6. G. Helmer, J. Wong, V Honavar, and L. Miller. Intelligent agents for intrusion detection. In Proceedings of the 2003 IEEE Information Technology Conference, pages 121-124, Syracuse, NY, USA, September 1998. IEEE Computer Society Press.

7. C.-L.-M. Harnold, K.Y. Lee, J. H. Lee and Y. M. Park, "Free-model based model reference adaptive inverse controller design for power plants," IEEE Power Engineering Society Summer Meeting, vol. 2, pp. 1208-1212, 1999.

8. C. C. Ku and K. Y. Lee, "Diagonal recurrent neural networks for dynamic system control," IEEE Trans. On

Neural Networks, vol. 6, no. 1, pp. 144-156, Jan. 1995.

**9.** Venkiteela, P. (2026). An Enterprise Agentic Architecture Framework for Agentic AI Governance and Scalable Autonomy. Scientific Journal of Computer Science, 2(1), 1–17. https://doi.org/10.64539/sjcs.v2i1.2026.368

**10.** M. Wooldridge and N.R. Jennings, "Intelligent agents: theory and practice," The Knowledge Engineering Review, vol. 10, (2), pp. 115-152, 1995.