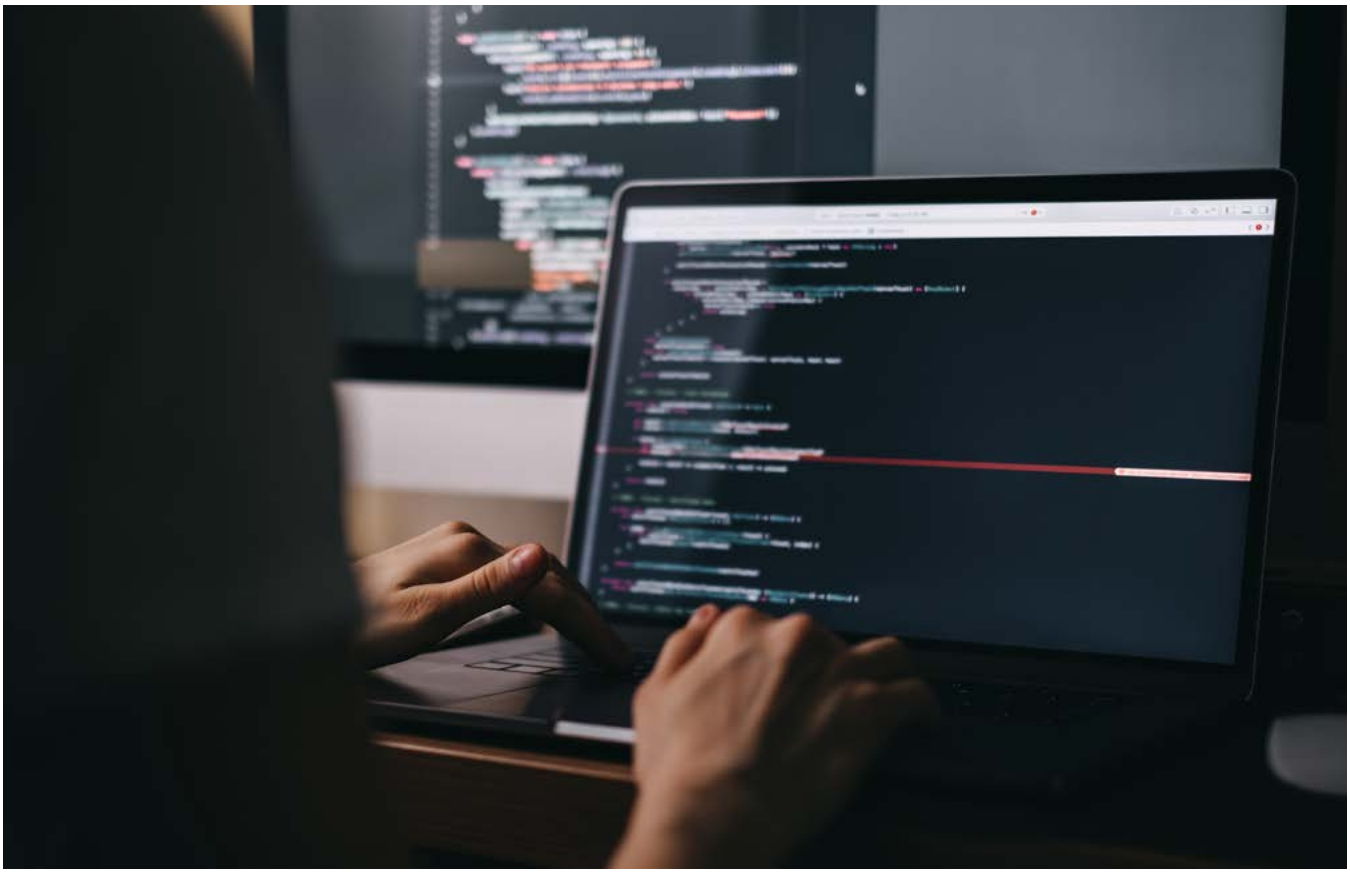

Significant improvements in generative AI are changing the nature of software in ways that demand a software-defined approach to intelligence. (AI-generated image of programmer working on a laptop, nickl-meel/Envato)

Software-Defined Intelligence

A New Way of Thinking About Tradecraft

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In the fall of 2023, I argued in these pages for rethinking intelligence analysis around the principles of software development.[1] I contended that Marc Andreesen's insight that "anything that can be software will be software" is as true for analytic production as for consumer applications.[2] I also made brief mention of emerging capabilities in generative artificial intelligence (GenAI) such as ChatGPT 4.0 that suggested this trend would continue if not intensify. Events since then have shown clearly that the accelerating pace of technological change are increasing the pressures for radical change in intelligence processes to meet customer demands.[3] In this article, I offer a new paradigm for thinking not only about analytic transformation, but about a broader change in our thinking about the craft of intelligence—the concept of "software-defined intelligence" based on prior work on software-defined warfare. I will outline six different forms or subcomponents of software-defined intelligence and propose a series of investments and policy changes to enable this change. Absent change, we risk having the IC find itself obsolete before it knows it.

Defining Software-Defined Intelligence

In 2022, then-CIA Chief Technology Officer Nand Mulchandani and retired Air Force Lt. Gen. Jack Shanahan pioneered the concept of "software-defined warfare" in a paper for the Center for Strategic and International Studies.[4] In 2025, the Commission on Software-Defined Warfare defined the term as "a paradigm of the continuous integration and delivery of cutting-edge technology and leading interoperable software into legacy and future defense systems to drive a software-centric, hardware-enabled approach to warfighting."[5] As Mulchandani and Shanahan said in their 2022 report, "Software needs to be at the core of every business and operating model before any business can hope to gain an enduring advantage. The DOD is no different."

If the military is no different, the same can certainly be said of the Intelligence Community—indeed, even more so. Unlike the military services, which rely on advanced hardware (especially in the Navy and Air Force) to achieve their missions, the vast majority of the IC is in the information—thus the software—business.[6] All intelligence is information, and all information in the intelligence process is digitized at some point.[7] This means that a pivot away from manual processes and mindsets to one that embraces the digital is necessary to avoid obsolescence.

Software-defined intelligence is a mindset and a philosophy. It answers the question: How do we solve this intelligence problem with a software-first approach? It leans into automation, integration, and human-machine teaming to allow intelligence officers to excel at what humans excel at, not wasting their scarce time and expertise on arenas better served by computers.[8] It enables the continuous evolution of business processes by having rapidly scalable and changeable software at the core of all activities. To fully adopt software-defined intelligence, however, we have to go beyond legacy software processes.

Changing Nature of Software

Significant improvements in generative AI are changing the nature of software in ways that demand a software-defined approach to intelligence. In particular, the growth of agentic AI and "vibe coding" have so radically reduced the barriers to creating software that Andreessen's prediction of software eating the world may emerge sooner than expected. I did not foresee these developments in my 2023 essay, but if anything, two developing and overlapping trends—agentic artificial intelligence (AI) and so-called "vibe coding"—offer the prospect of deep transformation.

Agentic AI is the next generation of development beyond the large language models (LLMs) that reshaped the world with the release of ChatGPT 4. Unlike standard LLMs, which generate text, video, or visual representations based on a prompt, agents can be thought of as software that completes tasks.[9] While a year ago there was debate around the impact and prospects for agentic AI, the release of Claude's Mythos and Fable models and OpenAI's ChatGPT 5.6 model have laid those to rest, especially given their observed effects on both the private and public sectors.[10] Progress in capabilities fielded by the frontier labs just since the beginning of 2026 indicates progress is starting to grow at such a pace, particularly in software development, that it is having macroeconomic effects and reshaping the market for early-career coders.[11]

When fully scaled as currently imagined, agentic AI can complete—in some respects is already completing—complex tasks without human intervention. Focused on programming as opposed to human language, the agents can automate scripts, connect systems together, and perform other key functions. While the technology has yet to fully mature, it offers the prospect of significant gains for automation, particularly when paired with AI orchestration to combine agents.[12]

A subset of agentic AI has already caught the popular imagination. AI pioneer Andrej Karpathy

coined the term "vibe coding" in February 2025 to describe leveraging AI agents to write code for applications without any human programming.[13] Vibe coding radically reduces barriers to entry for bringing software to bear for any computer task—including the digital tasks all intelligence officers conduct.[14] While imperfect, being able to rapidly generate and execute code means that the "software-ization" of the digital world will accelerate.[15] We have seen this over the last year at speed and scale.

One example of this relevant to intelligence appeared at the June 2025 AI+ Expo, sponsored by the Special Competitive Studies Project. Anthropic, the frontier AI lab whose Claude Code software is the market leader, demonstrated the ability in less than 10 minutes to build a functional application displaying more than 3 million unstructured signals from ship beacons, including a geospatial layer and tracks over time.[16] How long would it take a team of IC officers using traditional tools to generate the same results? Since then, frontier lab capabilities have accelerated faster than anticipated and people are increasingly using these tools in day-to-day life.

In 2023, I argued that, at least for analysis, the time was ripe to imagine software as a model for delivering insight at speed. These developments transcend analysis—they will pervade every element of the intelligence process, and failure to grasp them and leverage them at scale will create systemic risks for the IC.

Building on Legacy Programs

Wholesale transformation of IC activities may feel impossible at first, particularly given budgetary and human capital constraints. The good news is that the move to a software-defined intelligence paradigm can build on investments over the last decade at multiple intelligence organizations that have blazed a path for progress.

The first is the IC's systemic investment in cloud computing, a necessary capability for any software-defined intelligence future.[17] Investments over the last decade in IC Gov Cloud and the IC Information Technology Enterprise (IC ITE) are fundamental and foundational to allow for the collaborative space demanded by software-defined intelligence.

The second is the paradigm shift toward object-based intelligence. Led by programs like NGA's Maven and DIA's Machine-Assisted Analytic Rapid-Repository System (MARS), object-based intelligence is the base layer for a significant amount of the processing needed for analytics at scale—the data software will need to compute for software-defined intelligence. Absent a properly structured base layer, the IC risks the classic statistical challenge of garbage in, garbage out.[18] MARS just reached initial operating capability in 2024, having launched in 2018, and is planned to reach full operating capability this year.[19] Maven transitioned from the Defense Department's Chief Digital and AI Office, where it began in 2017, to NGA in 2023.[20] Beyond that, the concept of object-based intelligence is increasingly prevalent in both defense and geospatial intelligence—but it needs to spread IC wide.[21]

At the same time, the vast majority of these have focused on analysis, as opposed to the full intelligence cycle. The software-defined intelligence paradigm requires that all components of intelligence, from collection to effects, be considered for disruption.

Six Elements of Software-Defined Intelligence

I argue that the paradigm of software-defined intelligence pervades all elements of the intelligence cycle and has implications for every component of and function in the IC. Six broad categories highlight this impact. In this introductory essay, I only briefly discuss each – follow-on assessments will explore implications and implementation of each.

Collection

We can imagine intelligence collection divided into digital-native and digital-enabled categories. Digital-native collection is technical collection (including open source) that collects digital information via machines. Digital-enabled collection is HUMINT that relies on digital capabilities to succeed for targeting and operational support.[a] The former is easier to imagine in a software-defined era, because agentic AI would enable everything from access development to defeating technical defenses.[22] On the latter side, software-defined collection would focus on identifying, mitigating, and eventually defeating the ubiquitous technical surveillance threat that holds espionage at risk.[23]

Processing, Exploitation, and Dissemination

Processing, exploitation, and dissemination (PED) is perhaps the most time-consuming aspect of the intelligence cycle and one where software-defined intelligence could yield the fastest and greatest advantages. All collection, whether digital-native or digital-enabled, goes from collectors to exploiters and analysts via software before being consumed by customers. Software therefore should radically speed the transmission of intelligence from the collection node to the sensemaking architecture (analysis). Especially in an era of ubiquitous data, edge processing will be increasingly necessary to distill valuable signal from noise before movement to data centers for machine exploitation.[24] Beyond that, exploitation and dissemination generated by agents in machine-native formats as opposed to natural language (or in addition to it) will be important for integration into object-based intelligence frameworks like MARS or NGA's Analytic Services Production Environment, as well as into application programming interfaces (APIs) for vibe-coded analytic and policy support applications.[25]

Analysis

Building on my prior "Agile Analysis" model, software-defined analysis would place machine intelligence at the heart of mapping pattern-of-life, a core requirement for any IC analytic account. To be clear, however, software-defined analysis is not outsourcing the analytic development process to machines—it enables humans to deliver more value-added work than the routine processes that take up significant bandwidth. Vibe coding makes possible the rapid fielding of analytics dashboards and custom applications that an analyst could tweak with the occasional advice of a supporting data scientist or programmer. It removes some of the human capital requirements of my original team approach to analysis and significantly speeds delivery.[26] Beyond that, agentic AI, combined with already existing LLMs, could transform the process of analytic editing and review, removing significant management overhead and speeding the delivery of insight to customers. These LLMs, when encoded with ICD 203, the CIA's style guide, and algorithms to detect bias and confidence levels, would significantly improve the quality and decrease potential politicization in analytic production when paired with agents to execute the quality control process.[27]

Defense and Security

As predatory adversarial capabilities spread and technology diffusion allows a greater number of actors to conduct counterintelligence activities, software-defined counterintelligence, cyber defense, supply chain risk management, and personnel and physical security measures will be critical to ensuring US decision advantage. The cybersecurity industry is already leaning heavily into AI-enabled defenses, and agentic AI is likely to speed these capabilities at the tactical edge.[28] ODNI has already implemented continuous evaluation as a framework for personnel security; agentic AI will be crucial to managing the spread and scope of this across the IC and with cleared private sector partners.[29] The Department of War is already exploring the use of AI for

a. Picking up a newspaper would be digital-enabled collection if the hardcopy paper were scanned and sent to someone. Downloading newspaper articles from a website would be digital-native collection.

supply chain risk management, a capability the IC could leverage at scale as well.[30] And as discussed above, agentic AI has applications not only for the detection and avoidance of ubiquitous technical surveillance, but can be harnessed at scale to detect foreign intelligence operations for both strategic defensive and offensive counterintelligence programs.[31]

Effects

Under Title 10 and Title 50 of the US Code, components of the IC are sometimes called upon not only to collect and analyze information but to conduct effects operations at the direction of the president or other senior leaders.[32] Software-defined effects go beyond cyber operations to also include how agentic AI and vibe coding, when paired with LLMs, can enable strategic and tactical precision effects. These include opportunities for wide-scale and precision messaging, potential disruption opportunities, and software enablement of other clandestine and covert activities.[33]

Infrastructure

The era of software-defined intelligence may have no more pervasive impact than on the enabling infrastructure and business systems that allow the IC to operate.[34] The private sector is already aggressively pursuing agentic AI for human resources, contract and budget, facilities, logistics, and other infrastructure requirements, as well as the business analytics that inform those infrastructure decisions.[35] As such, the IC can take advantage of private sector investments and rapidly scale efficiencies and effectiveness by harnessing these tools.

Enterprise Policy and Capability Requirements

Software-defined intelligence mandates enterprise architectures that can communicate with each other, and on which AI is pervasive. The answer cannot be a silo for an LLM with "normal software" elsewhere. Nor can it be an exclusive reliance on enterprise software solutions. Instead, IC architectures must enable coding at the edge—at the individual user level—with appropriate protections so that draft code does not spill into broader systems or yield systemic crashes. IC ITE is a strong starting point in this direction, but the fact that the IC still lacks an enterprise high-side system used by all members limits the interoperability that would be ideal for this approach.

Beyond technical capabilities—most of which are already feasible and available—the greater hurdle toward a software-defined intelligence approach is policy and regulations. A wide array of regulations and requirements govern the Authority To Operate (ATO) standard for secure computing at the Secret and Top Secret levels. As discussed below, risk management is integral to this approach—but not risk avoidance. Separate policies and regulations, such as Intelligence Community Directives (ICDs) that drive analysis and collection as well as department- and agency-specific regulations, do not embody this software-driven approach—but embedding these regulations within the software being fielded could yield further rewards.

Risk Management, Upskilling, and Software-Defined Intelligence

Risk management is the foundation of both the barriers to and the necessary conditions for software-defined intelligence. ICD 503, "Intelligence Community Information Environment Risk Management," is the standard for all software use in the IC and ATO accreditation.[36] Too often, risk management becomes risk avoidance because the consequences have typically been higher for acting and something going wrong than for not acting.[37] Technology is moving too fast to avoid action, but typical IC acquisition processes have relied on enterprise contracts with legacy vendors who provide individual software solutions. Agentic AI and vibe coding put these software solutions in the hands of individual officers, enabled by a back-end infrastructure and a level of trust and

empowerment that allows them to adapt at the tactical edge and the speed of mission.

At the same time, while agentic AI and vibe coding may appear to create a future where there is no need for software programmers, experts who have used these tools in the last year have actually reinforced that knowledge of coding and software development is still very valuable.[38] A conversational understanding of the nature of algorithms and some experience with hands-on coding is still a valuable skill, and indeed it may be more valuable than ever in this future where we expect individual intelligence officers to bring these capabilities to bear.

Next Steps

Software-defined intelligence is a framework. More than that, it is a mindset. This means that to bring it to fruition, those who agree with this perspective have to engage in the hard work of culture change. Advocates have already raised pieces of this, but more is needed—in particular, a mindset shift beyond the technologists to the mission users.

As a starting point, departments and agencies can look at their policies and regulations for those that either enable or hinder software-defined intelligence. At the IC level, a range of Intelligence Community Directives are a natural starting point. Beyond that, IC budgets and IT investments should further explore how to harness agentic AI at scale, and identify incubators or labs to prototype all six of the software-defined intelligence sectors discussed above. Failing to do so may well render the IC obsolete, faster than expected. ■

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