Complex Systems

"Finding Order in Complexity"

The lifecycles of highly complex software and data systems are in themselves complex. At each subsequent phase it is typical for a different combination of skills to be required as the project transitions. This means that some people phase out and some phase in at all levels – from senior program and technical leaders through UX, design, engineering, infrastructure, deployment and customer support. It may also require that the internal department or external vendor in the lead role during a particular phase be shifted to a different department or vendor as the project progresses.

At a high level these lifecycle phases typically include:

1. Concept; vision; imagined future reality including scope and major transitions through time
2. High level user experience (UX) and workflow
3. Requirements for language or culture localization and flexibility
4. Design – visuals, wireframes, physical mockups, style guides, etc.
5. Technology Infrastructure and Data Architecture
    a. This requires particular attention to the implications of both online and offline requirements for:
        i. user functionality
        ii. data acquisition, storage, access and analytics
        iii. communication between software subsystems, data warehouses, hardware modules, processors or components, and third-party subsystems throughout the entire ecosystem
        iv. networks and infrastructure
        v. application, network and system administration for purposes of user support; troubleshooting and creating fixes for bugs and problems; and for routine and scheduled maintenance
        vi. performance tuning so *everything* runs and responds fast enough to complete the computational tasks and to provide views, content access or communication to users in a crisp and timely manner
        vii. requirements for compliance in all forms
        viii. requirements for configuration and dynamic reconfiguration / flexibility.
        ix. scalability
            1. the scope of individual deployments
            2. the quantity of individual deployments
            3. the variety of individual deployments, brands, experiences
6. Building the System
    a. Make vs buy of components and services – including hardware, software, subsystems
    b. Infrastructure
    c. Hardware

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    d. Software programming
    e. Data Repositories
    f. Third party subsystems such as digital asset management, players, business intelligence
7. Prototyping: NOTE: It must be determined if any aspects of the system are risky in terms of technical feasibility, scalability, performance, user acceptance or intuitiveness, etc., and these must be prototyped and evaluated prior to pushing ahead with Productization
8. Productization – redesigning, refactoring, rebuilding prototypes, documenting and testing to assure that the finished product as built will be sufficient for broad deployment as a reliable, robust, secure and functional system serving delighted users and providing desired visibility and analytics to stakeholders
9. System integration
    a. Testing, troubleshooting, debugging
    b. Corrective action
    c. Refactoring and preparation for deployment
    d. Extensive documentation and preparation of training materials
    e. Phasing in of the Sustaining Engineering team
    f. Exhaustive design and architecture reviews at all levels, including third-party subsystems
10. Beta testing
    a. More testing, troubleshooting, debugging, refactoring in a live environment with real users
11. Production Deployment
    a. Field Installations
    b. More testing troubleshooting, debugging
    c. Transition of product ownership to Sustaining Engineering and User Support teams
12. Continuous Improvement and Scaling-Up
    a. More testing, troubleshooting, debugging, refactoring as the system begins to scale up and out
    b. Scheduled incremental releases
    c. Preparation for the next major version or generation
    d. Ongoing recruiting, hiring, training of Sustaining Engineering & User Support Personnel
    e. … forever until it is all brought to a carefully orchestrated end.

OBSERVATIONS from 40 years of industry experience: It should not be expected that a single group of individuals or project teams, whether internal, external, or even a mix, will be able to take a highly complex system through this sequence of phases from Concept through Production Deployment and into the Continuous Improvement and Scaling-Up phases. In fact, even the senior program leaders often need to transition as vision transforms into reality, and the visionaries or R&D experts begin to focus on the next generation.

In order for these transitions to take place in complex systems, they need to be intentionally anticipated, discussed, planned out, provided for and executed. No resource must be allowed to keep secrets; to pass along “black boxes” to other organizations; to fail to document or cross-train. Highly visible, formal and extensive design and architecture reviews must be regularly held with serious go/no go decisions made crisply phase-by-phase by the program directors and stakeholders. One benefit is that this will also provide real-time visibility into changes in requirements, schedules, required personnel and dollars, the feasibility of imagined solutions, and the implications thereof.

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When parties fail to fulfil their roles and carry out their responsibilities in a sufficient manner, or when things slip through the cracks allow the way, a complex project will begin to slip schedules, over-run budgets, fail to function as desired, or fail to scale-up after Deployment. If not detected and corrected phase-by-phase, the overall project may fail ("a blown project") while the parties end up in litigation.

M28 Global is adept at working with the stakeholders of complex software and data-intensive systems to:

1. assess the current reality through design reviews with internal and external parties;
2. consult on corrective actions or alternative paths forward as required;
3. mediate between parties during contract disputes prior to litigation to resolve bottle-necks and move the project ahead;
4. troubleshoot and debug complex systems issues related to software, data or third-party integration
5. performance tune the software, databases, networks to shorten the system response times and increase reliability
6. refactor or redesign to increase flexibility for language or cultural localization
7. review and improve the User Experience (UX) employing User Centered Design principles
8. reverse-engineer software and data systems which were delivered or abandoned without sufficient documentation or cross-training
9. in extreme circumstances, rearchitect systems for scalability, flexibility, reliability or security where the original design and implementation is functional but fails to address some of these key requirements

Representative complex systems which M28 Global principals and staff have worked on since 1980:

1. ATEQ CORE-2500 Semiconductor Lithography System
2. Intel Semiconductor Fabrication Production Lines
3. Intel Corporate Business Intelligence Systems
4. Nike Global Supply Chain Systems
5. Jesus Film Project Arclight System: architecting, designing, building a digital asset management and deployment system using cloud services for 100,000+ video files in 1,500+ languages. This system includes iOS and Android mobile apps along with websites for user access to media, and sophisticated analytics subsystems for reporting and visibility into media access and the user experience; UI localization in 16 languages.
6. GCM iShare System: Business Intelligence system deployed in 100+ countries facilitating data gathering by dozens of independent organizations with a variety of data security requirements. Primary output and visibility into consolidated activities throughout the world is through complex mapping systems using geospatial services from ESRI, Google, GADM (the Database of Global Administrative Areas) and others. Localization into multiple languages.
7. FCI Health Plans: Redesigned processing flow and data analytics to clear the logjam in health plan payment processing to Medicare/Medicaid providers in the state of Oregon.
8. Forensic investigation, reverse engineering, expert analysis and testimony for attorneys and parties in litigation (or pre-litigation) related to contract disputes involving failed IT projects or misappropriated intellectual property.
9. Code porting and performance tuning for supercomputers and high-performance parallel systems.