# Building Intelligent Organizations

## Why Executives should Revisit their Management Systems

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*Abstract- Management systems in engineering organizations typically focus on processes to control core work and meet quality standards. Recent emphasis on integrated management systems has largely maintained this approach, without creating new strategies for aligning key human system aspects of the organization. Senior executives who approach management system integration from a broader perspective that treats the human system as the "new technology" are more likely to develop resilient, sustainable organizations. This approach focuses on integrating the human system, management system processes, and technological systems in the specific context under which the organization operates. Current standards related to management systems do not adequately facilitate such integration. Successful systems are designed from the perspective of the work the organization needs to accomplish to achieve desired outcomes rather than from standards alone. The capacity to develop intelligent organizational systems depends on understanding key attributes, including stage of evolution of the organization, organizations as creative chains, and organizational diversity and capacity at different levels of the organization. Understanding and mitigating risks associated with common propensities within technical and engineering organizations enables the development of more adaptable, resilient organizations.*

*Keywords– Management; Integrated Management Systems; Intelligent Organizations; Human System; Organizational Evolution; Continual Improvement*

## I. INTRODUCTION: MANAGEMENT SYSTEM THINKING – ORIGINS, ISSUES, AND DIRECTIONS

The evolution of management systems has gone through numerous phases since the 1950s: from quality control, to quality assurance, to total quality management, to integrated management systems. Various international standards for management systems exist [1-5]. Organizations that develop management systems focused on standards often end up with a poorly integrated collection of programs and practices that meet requirements on paper, but are difficult to implement effectively.

Management Systems are used by organizations to manage both business and operational aspects. In a manufacturing organization this could be to improve the quality of the product being produced, or to ensure the health and safety of manufacturers and customers. Business aspects could include measures to help protect the intellectual property used in the manufacture of products, or to protect information entrusted to the manufacturer by a third party. In simple terms, management systems establish the 6 p's: principles, policies, practices, programs, processes and procedures that are then resourced to enable the organization to achieve its objectives in the short and long term.

Executives in technical organizations often regard programs and processes as a means by which to control the work of others rather than as a way to comprehend how the work of the organization fits together and gets done. A belief that detailed procedures will shape behaviours and achieve the right results fosters a mechanistic, task-based focus on adherence to policies, programs, and processes without due regard for integration with the human system. This leads to organizational cultures in which leaders reinforce standards and 'expectations' rather than engage the full intelligence of the human system to enhance performance. In this context, we define a human system as a multi-dimensional, self-regulating interplay of meaning systems, intentions, and capabilities at the team, organizational, and societal levels.

Management systems that have evolved incrementally from technically-focused quality assurance programs often leave organizations without an appreciation that resilient organizations require a different approach to remain innovative and competitive. Fully functional management systems serve as a key framework for organizational design, risk management, knowledge management, governance, oversight, culture, and a host of other non-technical aspects required for success.

We propose that the evolution into "intelligent organizations" requires executives and managers to take steps to understand the human system as the "new technology" and to devote attention to establishing systemic coherence among five complex simultaneous organizing systems:

- the organizational structure used as a basis for position descriptions and boundaries;
- the human system and its competencies, innate propensities, and behaviours that give rise to relational and power dynamics;
- the interaction between people and management system processes;
- the evolving hard or soft technology on which the organization is based; and
- the evolving internal and external context in which the organization operates.

In this paper we develop a number of essential concepts that serve as a gateway to strengthening organizational capacity and resilience. These include stages of organizational evolution, propensities of technical organizations, creative chains, executive and governance

processes, and continual improvement. In discussing continual improvement, we provide an expanded view of the classical plan-do-check-act cycle that encourages a more proactive view that common corrective and preventive action programs commonly used by many organizations.

We conclude with a discussion of strategic approaches to enhance integration.

## II. ORGANIZATIONAL EVOLUTION, PROPENSITIES, AND CAPACITY

Figure 1 shows a model of the relationship between stages of evolution and propensities [6]. We define propensity as a natural inclination or tendency to behave in a particular way. Propensities are deeply connected with individual meaning systems and represent personal preferences for how we habitually think and act. Propensities make us more likely to pursue and succeed at performing some activities than others. They operate at the individual, team, and organizational levels.

Organizations evolve in order to mitigate risks and realize opportunities. Their journey towards increasing effectiveness and sustainability typically involves an expansion of focus from the technological system, to the management system, to the human system, eventually arriving at an integrated view of the entire system including its ties to the broader socio-ecological system. Their ability to negotiate this evolutionary path is directly influenced by resident propensities and meaning systems. Conscious adaptation requires organizations to understand their meaning system and propensities, and to determine what needs to be strengthened to facilitate adaptation to the next level of risk mitigation and opportunity realization.

Each stage of organizational evolution involves differences in focus, approach, and leadership. For an organization to be resilient, it requires at least some attributes of every stage. Through understanding the propensities that need to have a 'voice' and inform organizational meaning systems at each stage, organizations can increase opportunities to consciously and proactively seed their own evolution as opposed to reacting, adjusting, and potentially failing at crisis points.
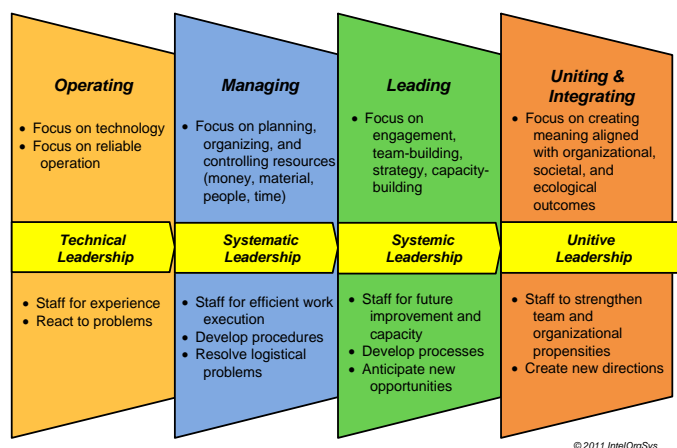


Fig. 1 Organizational Evolution and Propensity Model

The stages in Figure 1 are:

*Stage 1 – Operating:* At the core of every organization is a hard or soft technology that defines the nature of its business. In the start-up and early creation phase, organizations focus on operating and enhancing their technology. Expert knowledge is prized for its ability to solve technical problems. Leadership becomes synonymous with technical competence and such individuals typically rise to positions of power and influence. Outcomes are viewed in concrete product terms, and employees are used to react to technical issues. Risk management tends to focus on the consequences of technical failures. The overall emphasis is on keeping the technology functioning. At this stage, the leadership propensity profile is likely to reflect the propensities relevant to the particular occupational theme such as engineering, with relatively little diversity in other ranks.

*Stage 2 – Managing:* As organizations grow, they begin to experience challenges in quality and productivity that require enhanced controls. Procedures, planning, and resource management become more formalized. Emphasis expands from technical aspects to logistical thinking aimed at improving resource utilization and work execution. Clear expectations for performance are used to improve productivity. Outcomes are viewed in financial and production terms, and employees are used to resolve operating challenges. Risk management expands to encompass financial concerns and regulatory compliance. The overall emphasis is on achieving business results. At this stage, the leadership propensity profile begins to emphasize productivity, both in terms of organizational performance and human satisfaction. Utilitarian leaders view themselves as demonstrations of how teams can work to everyone's fulfillment.

*Stage 3 – Leading:* Stricter management controls enhance viability; however, they eventually give rise to issues related to employee motivation, satisfaction, and even loyalty. In response, emphasis shifts to include leadership development, team building, empowerment and a myriad of other efforts to boost morale and discretionary effort. Vision, mission, values, organizational culture, and strategic planning become a focus for enhancing organizational effectiveness. Processes and procedures become integrated into formal management systems. Employees are perceived as the means by which the organization distinguishes itself from its competitors, and their willingness to actively promote the organization's interests becomes important. Risk management expands to include issues related to organizational capacity and sustainability. The overall emphasis is on capitalizing on new opportunities within and outside the organization. At this stage, the leadership propensity profile likely begins to value relatedness, consensus building, and human development. They use socialization as the means to enhance cooperative effort.

*Stage 4 – Integrating-Uniting:* Advanced organizations recognize that long term sustainability requires them to pay attention to building and sustaining their capacity to

anticipate, innovate and initiate changes on a societal and global level. The focus is on long term strategies, citizenship, contribution to society, and integration across organizational, national, political, and social lines. Employees are perceived as active participants in shaping the fabric and direction of the organization. Emphasis is placed on developing conditions that enable the full creativity and intelligence of the human system to flourish. These leading edge organizations continually shape and transform the nature of society itself through their exploration of new thought systems and new technologies. To achieve this level of performance, these organizations align meaning, propensities and systems to create new directions. Leaders who operate at this level focus on the functioning of complex systems and their interfaces. They look beyond the constraints of existing systems to create transformative solutions. At this stage, the propensity profile emphasizes shared decision-making and problem solving, optimism, enthusiasm, and a willingness to provide new learning opportunities in a supportive climate.

Each stage has distinct preferences in terms of:
- Management and leadership style;
- Staffing and talent management;
- Reasoning and acting in particular ways (prioritizing, problem solving, decision-making, change management, risk management); and
- Building and using the management system to configure, support, guide and oversee work.

These preferences have a direct impact on the ability of organizations to envision, develop and operationalize coherent management systems. Different stages integrate structures and processes/procedures differently, with a general shift in focus from discipline or specialty; to program or department; to productive/creative chains and interdependent teams; to systemic/systematic formation of outcome-focused process groups tasked with defining strategy and managing risk.

The stages also determine the predominant organizational culture, appetite and capacity for change, as well as its approach to investing in learning and development. Organizations that understand the stage they are at can proactively shape their future development.

It is readily apparent that despite the overall importance of quality standards, their fundamental application and specificity changes significantly from left to right. Whereas an engineering or technical standard can provide explicit performance criteria for Stage 1 and some Stage 2 activities, a management system standard applicable to Stages 3 and 4, and indeed the entire system, is by necessity more generic. For this reason, the activities associated with all stages have to be well understood before a management system standard can be intelligently applied. Inherent in this is also the recognition that an audit and compliance mindset is often unable to diagnose underlying causes of organizational effectiveness issues beyond general admonitions of failures in supervision and leadership. Audits and assessments rarely explore the overall functionality and coherence of the management system processes and their related organizational systems.

## III. PROPENSITIES IN TECHNICAL ORGANIZATIONS

As indicated in the previous section, a propensity is a natural, in-born preference to reason and act in a particular way or be drawn to and succeed at particular activities. Propensities cannot be trained-in, skilled-in, or performance managed-in. A competency, in turn, is a developed skill that may be enhanced through training or experience. Alignment of propensities and competencies enables the potential for high levels of performance, achievement and satisfaction.

Table 1 on the following page illustrates the propensities most strongly associated with success in several career themes including engineering, senior management, social sciences, education, consulting, and law and politics. The data derive from an on-going study of 30,000+ individuals spanning over 30 years and 35 career themes [7].

The first column represents the predominant strengths (good to excellent behavioural factors or propensities) and potential blind spots (low values) in engineering professions. The second column reflects the strengths most commonly associated with success in senior roles. Behavioural strengths combine to shape performance. For example, the tendency of senior executives towards low consensus building facilitates and amplifies their preference for decisive leadership.

The remaining columns identify propensities associated with career themes that progressively focus on human networking, adaptability, and societal impact. Individuals with preferences for these themes exhibit more interest in culture, human systems, motivation, development, and providing advice and guidance rather than direct management. Technical organizations typically do not engage individuals with these preferences, and so do not possess some of the strengths needed to resolve a range of systemic issues.

## IV. ORGANIZATIONS AS CREATIVE CHAINS

Organizations are creative chains that turn inputs into outputs. Depending on the stage of evolution, the creative chain is capable of a wide range of adaptive processes as illustrated in Figure 2. The chain essentially represents a productivity chain in which operational and tactical inventiveness increases towards the left and strategic inventiveness increases towards the right.

It is apparent that quality standards are more relevant and effective towards the left. It is also apparent that markedly different propensities are required at different management levels across the entire chain.

Technical organizations can systematically improve quality, risk management and adaptability by applying this creative chain in the context of their operating environments, and designing both their human and management systems to support the work, desired culture, and outcomes of the organization.
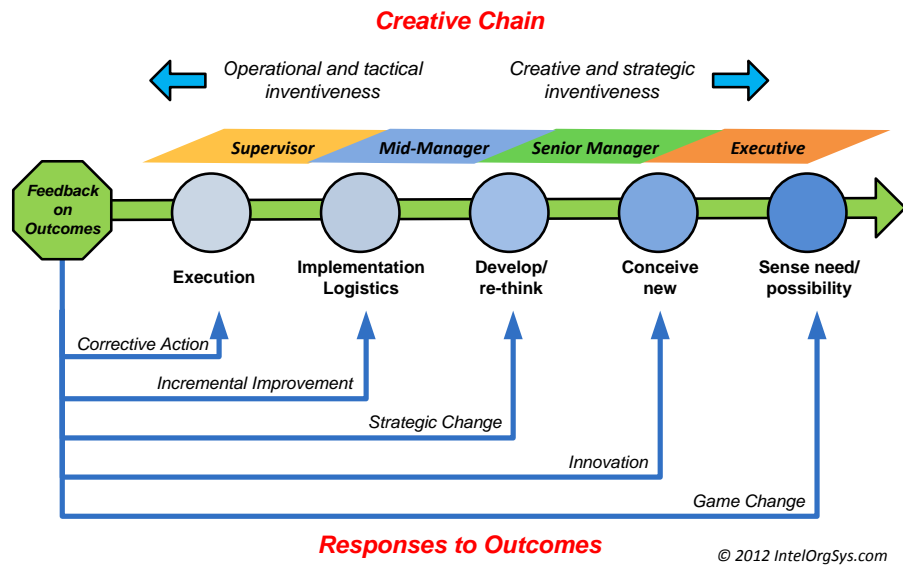
**Creative Chain**

Operational and tactical
inventiveness

Creative and strategic
inventiveness

Supervisor    Mid-Manager    Senior Manager    Executive

Feedback
on
Outcomes

Execution    Implementation
Logistics    Develop/
re-think    Conceive
new    Sense need/
possibility

Corrective Action

Incremental Improvement

Strategic Change

Innovation

Game Change

**Responses to Outcomes**

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Fig. 2 Organizational Creative Chain

TABLE 1 AGGREGATE PROPENSITIES RELATED TO SUCCESS IN SELECTED OCCUPATIONAL THEMES

| Engineering | Senior Executive | Social Sciences | Education | Consulting | Law and Politics |
|---|---|---|---|---|---|
| **Good to Excellent** | **Good to Excellent** | **Good to Excellent** | **Good to Excellent** | **Good to Excellent** | **Good to Excellent** |
| • Reasons critically<br>• Builds consensus<br>• Demonstrates character<br>• Thinks conceptually<br>• Strives for excellence<br>• Overcomes adversity<br>• Maintains accountability | • Leads decisively<br>• Seeks innovation<br>• Focuses on results<br>• Initiates independently<br>• Thrives on chaos<br>• Demonstrates social charisma<br>• Sustains profitability<br>• Maintains accountability<br>• Manages stress<br>• Reasons critically<br>• Exercises political influence | • Maintains accountability<br>• Seeks innovation<br>• Demonstrates community consciousness<br>• Establishes alliances<br>• Demonstrates strategic vision<br>• Communicates clarity<br>• Strives for excellence<br>• Establishes order | • Communicates clarity<br>• Thinks conceptually<br>• Demonstrates community consciousness<br>• Builds consensus<br>• Demonstrates character<br>• Maintains accountability<br>• Establishes alliances | • Thinks conceptually<br>• Focuses on results<br>• Communicates clarity<br>• Establishes alliances<br>• Demonstrates strategic vision<br>• Demonstrates character<br>• Maintains accountability<br>• Demonstrates community consciousness<br>• Builds consensus<br>• Manages stress | • Communicates clarity<br>• Leads decisively<br>• Thinks conceptually<br>• Demonstrates strategic vision<br>• Utilizes humor<br>• Reasons critically<br>• Strives for excellence<br>• Maintains accountability |
| **Low** | **Low** | **Low** | **Low** | **Low** | **Low** |
| • Manages self<br>• Establishes order<br>• Communicates clarity<br>• Sustains profitability<br>• Demonstrates social charisma<br>• Demonstrates community consciousness<br>• Seeks innovation<br>• Exercises political influence<br>• Drives achievement | • Communicates clarity<br>• Manages self<br>• Builds consensus<br>• Demonstrates community consciousness<br>• Demonstrates character<br>• Thinks conceptually<br>• Demonstrates strategic vision<br>• Establishes alliances<br>• Utilizes humour<br>• Strives for excellence<br>• Establishes order | • Builds consensus<br>• Thinks conceptually<br>• Exercises political influence<br>• Overcomes adversity<br>• Utilizes humour<br>• Demonstrates social charisma<br>• Demonstrates energetic enthusiasm<br>• Manages self<br>• Thrives on chaos<br>• Reasons critically<br>• Drives achievement<br>• Focuses on results | • Focus on results<br>• Manages self<br>• Initiates independently<br>• Demonstrates energetic enthusiasm<br>• Reasons critically<br>• Utilizes humor<br>• Exercises political influence<br>• Thrives on chaos<br>• Overcomes adversity<br>• Drives achievement<br>• Sustains profitability | • Manages self<br>• Overcomes adversity<br>• Exercises political influence<br>• Sustains profitability | • Builds consensus<br>• Responsive to change<br>• Seeks innovation<br>• Demonstrates community consciousness<br>• Exercises political influence<br>• Sustains profitability<br>• Drives achievement |

*[Note: Averages are not included in the above table] (Ref. 7)*

As an explicit example, Table 2 provides a sample of activities relevant to each level of an organization from supervisor to executive. The nature, scope, and timelines of the activities change across the spectrum. The bottom section of the table illustrates the dominant propensities associated with success at each level [7]. Failure to understand the different propensities required for success at different levels leads to various staffing and succession errors that readily undermine organizational performance. Technical organizations are prone to overlooking these risks because they tend to pay less attention to key human system elements, such as resourcing strategies.

Several factors commonly impede the effectiveness of organizational resourcing:

- There is a natural tendency for supervisors and managers to experience greater rapport with those who have similar personality traits. This increases the likelihood that they will 'clone' themselves in the hiring process, thereby limiting needed diversity of propensities in the talent pool.

TABLE 2 SAMPLE ACCOUNTABILITIES AND PROPENSITIES BY LEADER LEVEL

| Supervisor | Mid Manager | Senior Manager | Executive/CEO |
|---|---|---|---|
| **Selected Activities/Accountabilities** | | | |
| • Assign and coordinate work<br>• Communicate operational priorities and constraints<br>• Monitor and coach employee performance<br>• Promote a continuous learning environment<br>• Promote openness<br>• Establish team learning plans<br>• Foster diversity values<br>• Promote standards and expectations<br>• Promote process adherence<br>• Provide field presence<br>• Recognize employee contributions<br>• Remove barriers to employee performance<br>• Welcome innovative thinking<br>• Welcome staff feedback and inquiries<br>• Report significant issues to management | • Allocate resources<br>• Align programs and processes with the organization vision<br>• Manage projects<br>• Manage costs<br>• Manage departments, facilities and inventory<br>• Monitor program/process effectiveness<br>• Monitor customer satisfaction<br>• Provide for knowledge transfer and retention<br>• Align training to performance needs<br>• Develop and maintain relationships with industry peers<br>• Foster vendor and supplier relationships<br>• Evaluate business solutions<br>• Advocate process improvement<br>• Align processes and programs with regulatory standards | • Assess organizational risk<br>• Assess organizational effectiveness and performance<br>• Formulate and enact business strategy and plans<br>• Promote desired organizational culture<br>• Explore business innovation opportunities<br>• Align management system and organizational structures<br>• Introduce new technology solutions<br>• Develop and maintain relationships with business, regulatory bodies, etc.<br>• Protect organizational interests<br>• Assess and develop workforce capacity<br>• Perform infrastructure planning | • Monitor and assess political, economic, societal, technological, ecological, and trends at national and global levels<br>• Monitor organizational coherence and integration<br>• Define business outcomes<br>• Establish the organization's vision and mission<br>• Establish strategic plans<br>• Establish expectations for external relationships<br>• Monitor community, social and environmental impact<br>• Manage mergers and acquisitions<br>• Perform strategic partnering<br>• Undertake business development<br>• Undertake strategic organizational transformation<br>• Manage corporate visibility<br>• Promote a positive image of the organization |
| **Propensities (Good to Excellent)** | | | |
| • Demonstrates character<br>• Leads decisively<br>• Reasons critically<br>• Maintains accountability | • Reasons critically<br>• Builds consensus<br>• Demonstrates character<br>• Responsive to change<br>• Strives for excellence<br>• Focuses on results | • Leads decisively<br>• Focuses on results<br>• Maintains accountability<br>• Demonstrates energetic enthusiasm<br>• Reasons critically<br>• Initiates independently<br>• Sustains profitability<br>• Thrives on chaos | • Leads decisively<br>• Seeks innovation<br>• Focuses on results<br>• Initiates independently<br>• Thrives on chaos<br>• Demonstrates social charisma<br>• Sustains profitability<br>• Maintains accountability<br>• Manages stress<br>• Reasons critically<br>• Exercises political influence |

- Many leaders believe that demonstrated competencies and credentials are sufficient to make informed hiring decisions, whereas research suggests that innate propensities are more reliable predictors of job performance and satisfaction.
- Many leaders believe their job is to manage the group, rather than resource the team so it can significantly self-manage. This belief limits opportunities for engagement and creativity, and reduces the potential for higher-order productivity and intelligence inherent in groups.
- Dimensions such as humour and community consciousness that are highly valuable to healthy team dynamics are often overlooked.
- Hiring decisions for leader levels are frequently made by the next level up. This means that the

candidate pool for succession into more senior positions is prematurely constrained and may not contain the diversity of propensities required.

Senior executives often take the safe route of promoting internal talent within chains of command. In fact, many employees come to believe that the route to the top is from supervisor, to manager, to executive and maybe to CEO. This happens in spite of the well-known "Peter Principle" in which good people are promoted beyond their capability only to have their careers either stall or shift laterally. The negative impact on the individual and the organization persists until the person is reassigned, and often the process of recognition, acceptance, and reassignment is slow.

The promotion path approach is perpetuated by failure to recognize four important elements. First, as indicated by Table 2, different levels of management require fundamentally different talent sets. Second, individuals cannot simply flex their innate propensities to meet these differing needs. Third, talent within a specific discipline does not assure management capability within the same discipline. Finally, past performance doesn't predict future success in a different job. Exceptional performance results from an alignment of innate propensities and learned competencies in the context of the activities that need to be performed well in the new role.

For example, a supervisor may be very good at engaging and motivating her work group yet not have the strategic capacity to envision and lead the organization into the future. Similarly, a manager who is not oriented towards profitability may not demonstrate the financial-mindedness required to lead a successful commercial project. Or the best engineer may lack management competencies despite a wealth of technical talent and experience.

Put simply, managers need to focus inward and downward; CEOs need to focus outward and forward. The various levels of management involve different activities, mitigate different risks, and require distinctly different reasoning and relating patterns:

- Supervisors focus on organizing specific resources to accomplish tasks;
- Managers focus on processes, programs, logistics, and cost;
- Senior managers focus on organizational direction, integration and change; and
- Senior executives focus on stakeholders, way-finding, meaning making, and seeking new opportunities.

Sticking to traditional approaches to promotion common in technical organizations may ultimately leave organizations without the breadth of leadership talent needed to operationalize a fully functional management system. In addition, management may continue to focus on developing internal talent without recognizing that the return on investment in training poor-fit talent is marginal at best. Finally, and perhaps most importantly, the talent pool for senior positions becomes prematurely constrained by decisions made when promoting at the supervisory level, thereby eliminating talent with different skills sets that could be essential for success in more senior roles.

Although staffing for and managing diversity may be perceived as more challenging than managing homogeneity, diversity with mindful leadership leads to healthier, more viable organizations. By diversity, we mean the different reasoning and sense-making skills associated with different propensities, rather than the traditional meaning of gender, race, country of origin, or faith.

Engineering organizations can benefit from analyzing the nature of their performance challenges in terms of stage of evolution, dominant propensities, and leadership capacity to determine what strengths they can mindfully leverage or add to improve performance.

## V. MANAGEMENT SYSTEM DEVELOPMENT IN TECHNICAL ORGANIZATIONS

Technical organizations tend to focus on aspects of management systems that align with their preferences for core technical processes and issues, project execution, and short-term, hands-on problem-solving (Stages 1 and 2 orientation). The reality for sustainable organizations is that all four stages need attention by senior management. This requires seeding the requisite skills and propensities in strategic positions at various levels to ensure credible presence within the organization.

Figure 3 illustrates the components of an integrated organizational system, with a breakout to the management system process components. An integrated organizational system is one in which the alignment of an organization's human system, management system processes, technology, and external environment has been purposefully undertaken to achieve desired organizational and societal outcomes. In effect, an integrated organizational system is an extension of the traditional view of management systems that focus primarily on policy, programs, and processes. More specifically, it recognizes the importance of the human system as the integrative driving force behind all work. Programs, processes, and procedures that are not designed with human capacity in mind are less likely to be fully effective.

To varying degrees of success, engineering organizations develop core processes related to design and manufacturing, and support processes related to key functions such as staffing, accounting, and procurement. Not surprisingly, predominant propensities in technical organizations typically lead them to pay less attention to the Governance and Executive processes illustrated in Figures 4 and 5. These are often perceived to be "too fuzzy" or simply "what managers do automatically" rather than processes amenable to systematic development.
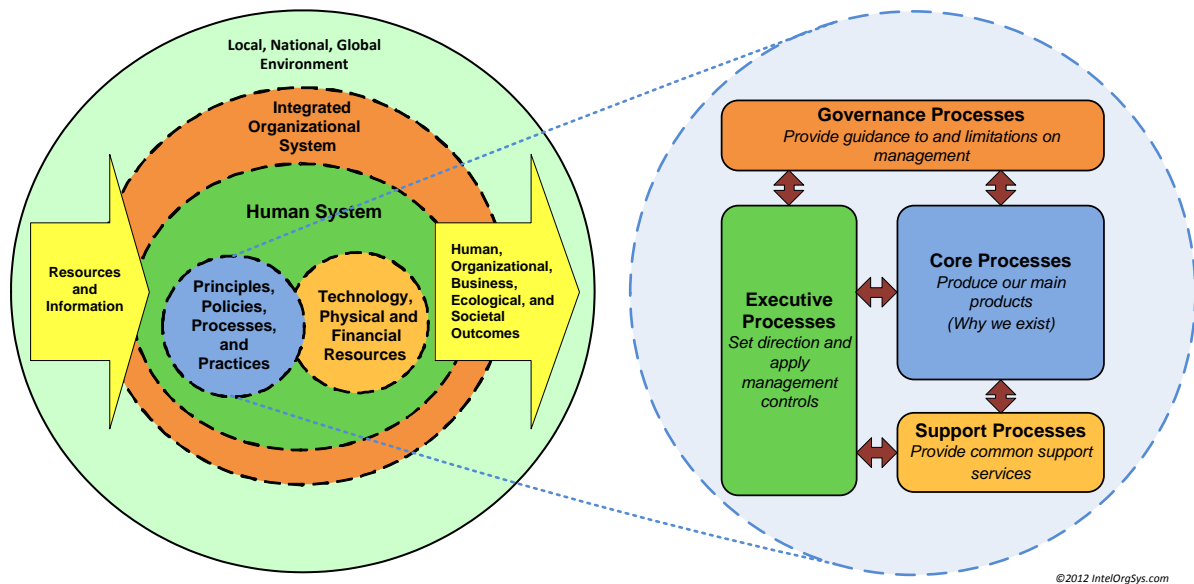
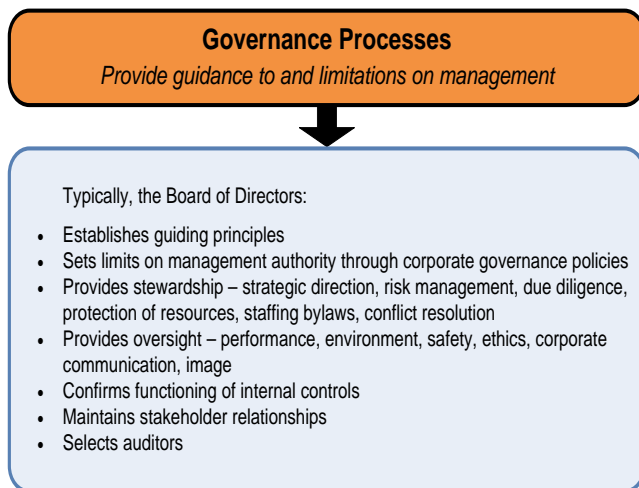Fig.3 Integrated Organizational System and Related Processes

## Governance Processes
### Provide guidance to and limitations on management

Typically, the Board of Directors:

- Establishes guiding principles
- Sets limits on management authority through corporate governance policies
- Provides stewardship – strategic direction, risk management, due diligence, protection of resources, staffing bylaws, conflict resolution
- Provides oversight – performance, environment, safety, ethics, corporate communication, image
- Confirms functioning of internal controls
- Maintains stakeholder relationships
- Selects auditors

Fig.4 Example Governance Processes

**Executive Processes**

*How we set direction and apply management controls*

*Examples:*

- **Direct and manage the organization**
- Manage the human system
- Manage external relationships
- Assess performance
- Improve performance
- Manage process integration

- *Develop strategic plans*
- *Develop business and organizational plans*
- *Develop operational plans*
- *Develop and monitor budgets*
- *Monitor and report performance*
- *Monitor and manage organizational risk*
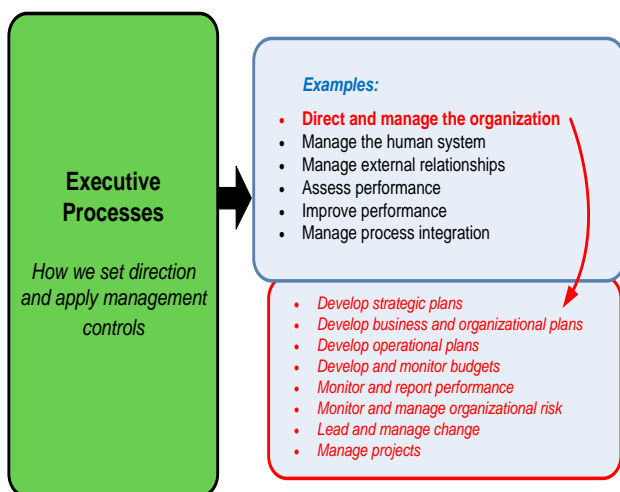- *Lead and manage change*
- *Manage projects*

Fig.5 Example Executive Processes and Sub-processes

Developing the elements of Figures 4 and 5 requires different talent sets than those of core and support processes. Although the management system has to engage the thought processes associated with Stages 1 and 2, both Stages 3 and 4 thinking are required to move the management system from standards application into its integrative purpose (human system, processes, technology, and context). Although it is a challenge to make all aspects of the management system relevant and engaging to all parts of the organization, failure by senior managers to understand and appropriately resource all essential aspects puts the organization at long-term risk.

Management system standards provide little practical guidance on how to develop, align, and implement many of the elements associated with integrated organizational systems represented by Figure 3. This is compounded for organizations that wish to consciously strengthen Stages 3 and 4 capacity without diluting their strengths in meeting standards at Stages 1 and 2. For this reason, management systems should be founded on the functionalities, work and desired outcomes of the organization, not just standards. In particular, executives and senior managers should be directly engaged in the development of top-level, cascadable models that define how the systems and work of the organization fit together.

Management systems have significant impact on organizational design, structure, culture, and vice versa. As such, they can be the primary improvement tool when developed with the full scope of risk management and ability needs of the organization in mind.

## VI. CONTINUAL IMPROVEMENT IN TECHNICAL ORGANIZATIONS

Possibly the most important contribution to ensuring long term viability and success of an organization relates to its capacity for continual improvement and, where needed, transformational change.

Different approaches to continual improvement are typically selected and preferred at each stage:

- Stage 1: find and fix – react;

- Stage 2: quality control – manage;
- Stage 3: continual improvement – shape;
- Stage 4: intentional development – create.

TABLE 3 APPROACHES TO CONTINUAL IMPROVEMENT BY STAGE

| Operating | Managing | Leading | Uniting and Integrating |
|---|---|---|---|
| React to problems | Resolve problems | Anticipate opportunities | Create new opportunities |
| Expected to do it | Assign people | Engage people | Inspire people |
| plan<br>**Do**<br>Check<br>act | **Plan**<br>**Do**<br>**Check**<br>adjust | look ahead<br>create<br>Design<br>**Plan**<br>**Organize**<br>**Implement**<br>**Monitor**<br>**Adjust** | **Envision**<br>**Create**<br>**Design**<br>Plan<br>organize<br>implement<br>**Oversee**<br>**Redirect** |

These approaches are illustrated in Table 3. The leading capital letters and bold text indicate the degree to which each element is emphasized within that stage.

Edwards Deming's classic 'Plan-Do-Check-Act' cycle is used by many organizations as an approach to achieving quality. The purpose of 'Plan' is generally separated into two main elements:

- **Policy and Principles:** to ensure the organization's commitment to meeting the requirements related to a management system standard, to establish an overall sense of direction and principles for action, and to develop and implement a framework for setting objectives and targets for the organization to work towards.

- **Planning:** to work towards the Policy and Principles by identifying needs and requirements, performing analysis of critical issues, selecting significant issues to be addressed, setting objectives and targets, identifying resources, identifying structures, roles, responsibilities and authorities, and planning operational processes and contingency preparedness for unforeseeable events.

Broadly speaking, 'Do' refers to implementing the plan while working towards the policy and principles set out by the organization's executives. As part of implementation, consideration is given to operational control and the management of human and other resources. It includes processes, procedures and other documents needed for implementation and operation. Communication and relationship-building with suppliers and contractors are also a key part of 'Do'.

'Check' is about monitoring and measuring to confirm that implementation meets the objectives, targets, standards, policy and principles set out under 'Plan'. An internal audit component provides independent verification. Part of 'Check' also involves analyzing and managing nonconformities.

Finally, 'Act' is about taking actions on nonconformities or other deficiencies detected during the 'check' phase. These are generally divided into corrective and preventative actions. Corrective actions result when something has gone wrong, and action is needed to correct the situation (reactive). Preventative action results when a deficiency is detected, but has not yet caused an incident (proactive). As an organization evolves into an "intelligent system" it becomes more proactive and spends less time, effort and resources 'firefighting' incidents.

Most organizations perform the 'Plan' and 'Do' parts of the cycle, but evidence suggests that many are less adept at performing the 'Check' and 'Act' steps. Both 'Check' and 'Act' are important parts of the cycle that ensure both the quality of implementation and continual improvement.

As indicated in Table 3, the fundamental nature of the 'Plan-Do-Check-Act' cycle changes with stage. 'Find-and-fix' approaches common to the application of the cycle become less effective for complex issues such as management effectiveness.

The management system supports different improvement methodologies across the stages. For example, audits and assessments typical of Stages 1 and 2 work with "knowns", i.e., gaps between current and desired states.

They shift into benchmarking, sharing operating experience, and exploring best practices in Stages 3 and 4. The latter stages begin to work with non-linear, complex systems such as culture, or emerging external contextual changes that require more anticipatory and developmental approaches. Stages 3 and 4 make extensive use of engagement techniques such as networking, focus groups, appreciative inquiry, and open space technology to tap into the intelligence of the human system. Successful application of these techniques requires different relational and problem-solving preferences.

The thinking styles associated with later stages are required to recognize and resolve problems arising out of earlier stages. Technical organizations are at risk of too little representation or valuing of later stage propensities. Organizations that consciously choose to engage the requisite diversity of talent can increase their capacity for continual improvement in all four stages.

## VII.    CONSIDERATIONS FOR SENIOR EXECUTIVES

What can executives and managers in engineering organizations do to enhance their organization's resilience and adaptability without diminishing existing strengths? Here are a few strategic considerations:

- Determine the stage of evolution of your organization and implications on performance and risk;
- Determine the state and alignment of your organizational systems, including the human system (organizational design, structure, dominant propensities and leadership styles), management system processes, and technology in the context of your operating environment;
- Clearly articulate the key process-based activities of senior and mid-level positions, not just their roles, responsibilities and accountabilities;
- Define the talents required for each key position and team (beyond knowledge, skills, and credentials) including functionality and the critical behavioural strengths or propensities needed to perform the activities effectively;
- Determine whether mid and senior level leadership teams have the aggregate propensities required to deliver on their mandates;
- Determine whether the talent assigned to overall integration and coherence of the human system, management system, and technology have the requisite propensities for strategic, systemic, and systematic thinking;
- Align resourcing and development dollars accordingly; and
- Ensure that predictors of future success, as well as team fit, form part of succession search criteria.

Clinging to traditional resourcing methods can result in overlooked talent, gaps in the requisite talent set at the management table, and a lack of sufficient talent in the succession pipeline. Executives who encourage their HR departments to think differently about staffing will develop more resilient, adaptable organizations, and reap the discretionary effort that comes from more engaged employees. In addition, the management system and related organizational systems will be more robust.

## VIII.    CONCLUSION

Executives and managers can systematically enhance performance and sustainability through the conscious development of their human and management systems. Organizational effectiveness requires integration and harmonization of agreed outcomes with the meaning systems that drive individual and collective actions. This extends to building aligned mechanisms and structures that support the human system, including management system processes, and organizational design and structure.

The stage of evolution of any organization affects its capacity to evolve, its ability to conceive and implement effective organizational systems, and its utilization of the full intelligence of its employees.

By understanding and mitigating the risks associated with homogeneity of propensities, executives and managers can expand the intelligence and adaptiveness of their organization's human systems.

By shifting from a reliance on the application of standards and expectations to designing and resourcing a creative chain, they can build a living management system aligned with the desired functionalities, culture and outcomes of the organization.

By taking a systemic and strategic view of the management system as the organization's primary improvement tool, they can manage short and long-term risks across the full dimensions of the organization.

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