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The Application of Knowledge and Continuous Learning to the Implementation of Collaborative Work Environments at Shell

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Abstract

Broad industry trends that are reshaping exploration and production (E&P) operations warrant a rethinking of traditional operating models as part of strategies designed to optimize the development and production of oil and gas assets. Shell E&P is introducing a new collaborative operating model as part of its global digital oilfield strategy. The collaborative model leverages the expertise of its global workforce through redesigned business processes and specially designed collaborative facilities to capture maximum benefits from its investment in smart digital oilfield technologies. Each collaborative environment shares a common, standards-based information technology (IT) architecture that can enable the linking of offices, platforms, and remote operation sites into a single global network providing real-time access to Shell E&P's community of expert practitioners and a common, shared institutional knowledge base. An important contributing factor to Shell E&P's success in introducing collaboration has been its ability to effectively shape a culture of collaboration and teamwork through trust, knowledge sharing, and continuous institutional learning. This paper examines one key element in the success of these collaborative centres by adopting innovative methods that Shell E&P is using to more effectively capture and share its institutional knowledge and experience through a culture of continuous enterprise learning. While this organizational transformation remains work in process, initial findings confirm the initiative is delivering tangible results towards the goal of optimizing production and recovery from assets.

Introduction

The E&P industry is undergoing a period of significant transition. The business now recognizes that there is no more "easy oil." New developments are more complex and more technically challenging; increasingly, they have multiple sites and are located in geographically remote regions. Operators also face a reality that there are fewer opportunities for new development, resulting in increased competition that is fueling continuous demands from resource owners to increase recovery from existing assets. Enhanced recovery requires operators to adopt new approaches to optimizing production by using sophisticated new "smart" technologies that are operationally challenging. These technologies require significant capital outlays that are accompanied by rising operating costs and the cost of environmental compliance and mitigation. Exploiting these new technologies requires staff to learn new skills, work together in new ways, and develop new capabilities that challenge traditional operating models.

This transformation is introducing significant organizational change at a time when the industry faces a shrinking pool of qualified new recruits and a "graying workforce" and is at risk of losing critical institutional knowledge and experience that are essential to overcoming these challenges. How the industry responds to these challenges will determine a new order in the E&P business as well as its ability to meet the resource demands of the world economy.

Background

Shell E&P is responding to these challenges through its global Smart Fields®[1] initiative, transforming its global assets into smart assets by establishing a foundation of core technologies[2] and collaborative work environments (CWE) that enable offshore and onshore personnel and experts worldwide to work together as teams to improve production performance and recovery of hydrocarbons throughout the value loop.[3] Smart Fields represents Shell E&P's vision and operational principles that provide individual assets the core capabilities necessary to achieve and sustain continuous optimization in the short-term and throughout the asset life cycle.

Collaboration across disciplines is one of the most important areas where we can gain real benefits in efficiency and effectiveness.
–Executive Director, Shell E&P

Smart Fields Programme

Smart Fields is implemented through a centrally coordinated Smart Fields Programme within Shell E&P's research and development (R&D) organization.[4] The Smart Fields Programme's charter is to provide leadership and to assist business units in implementing smartness through a core set of foundation technologies that enables near-real-time acquisition, modelling, and analysis of data for production optimization and reservoir management; the redesign of business processes to increase collaboration between offshore and onshore personnel in decision making and execution; and the implementation of CWEs, the platform on which Smart Fields operates.

A key role of the Smart Fields Programme is to work closely with business units to determine the level of smartness that is cost-effective, develop an asset-specific smartness road map and scope for Smart Fields initiatives, and then provide experienced resources and a common methodology to execute Smart Fields projects. Ultimately, smart capabilities will be implemented for all new greenfield developments and to the appropriate level of smartness for existing brownfield sites.[5]

Smart Fields can easily add 5 percent or 10 percent to annual production and extend the life of existing fields.
–Executive Director, Shell E&P

Global CWE Programme

The technology elements of Smart Fields are well understood. Initiatives to implement foundation technologies are well underway towards meeting implementation targets. In contrast, putting in place the organizational changes necessary to transform traditional siloed work environments, deploy global expert centres and 24/7 operational support capabilities, and build cross-disciplinary teams who share knowledge and experience for collaborative decision making raises very different challenges. As the platform on which Smart Fields operates, the principal challenge of CWEs is the human element.

Shell E&P recognized early that changing the way people work required a different approach that integrated the elements of people and process with technology and information. Implementing and operating technology solutions is one thing, but implementing and using these tools in a collaborative way among teams of users was something entirely different. In 2005, the Smart Fields Programme established the Global CWE Programme to focus on these new challenges.[6]

CWE is the heart of Smart Fields; without CWE there is no Smart Fields.
–Smart Fields Programme Manager

These challenges required an innovative approach. Building teams, establishing trust, and teaching people to work collaboratively have not been the focus of Shell E&P or other E&P operators for years. Nor did Shell E&P and other E&P operators have experience designing and implementing specialized facilities that would foster and support these new relationships. Based on that honest appraisal, the Global CWE Programme engaged experienced consultants, each specializing in a different aspect of CWEs, to develop a comprehensive, integrated methodology tailored to Shell E&P's specific applications and needs. Today, Shell E&P employs experienced implementation teams and, working with regional Smart Fields coordinators, provides business units and assets with a common approach, an established methodology, and the resources required to assess, scope, design, and implement CWEs tailored to each business unit's unique needs.[7]

Shell E&P's common approach and methodology for implementing CWEs provide important benefits for business units, assets, and Shell E&P:

- Improved communication across functions and disciplines and among partners
- Increased transparency of team analysis, rationale, and decision making
- Enhanced productivity and morale through alignment around shared goals and objectives
- Projects completed sooner, at lower cost, with lessened impact on business unit resources
- Architecture and technical standards that reduce integration costs and ensure interoperability of global CWEs
- Continuous improvements in the speed and success in completing CWE implementations
- Increased sharing and reuse of common solutions to address common implementation issues across Shell E&P
- Growing communities of experts and CWE practitioners across Shell E&P
- Increased ability to leverage customer input and integrate partners into problem solving
- Innovation to drive continuous improvement for future CWE implementations

Although many of these benefits are being realized by other E&P operators pursuing similar programmes, there are two elements to Shell E&P's programme that are unique:[8]

- Continuous Learning and Improvement — First, Shell E&P is committed to a philosophy of continuous learning and improvement that is reinforced by adopting a set of practices that capture knowledge and experience from each CWE implementation and apply key learnings and best practices to future implementations so that each successive implementation improves on previous experience.
- Industry Best Practices — Second, Shell E&P recognizes the importance of developing and sustaining a methodology that incorporates and tailors not only best practices from its own experience, but the experience of its partners, vendors, and other participants. Although integration complexity increases dramatically with each new participant, looking outside of Shell E&P and the Smart Fields Programme to capture the experience from throughout the industry ensures that Shell E&P continually applies and benefits from the best practices across the broadest base of experience.

For me what is important is how quickly we will roll CWEs out across the world. The real value comes when you have implemented ten and twenty CWEs, so for me it is important that we are fast in learning from experiencing the first and replicating it across many locations.
–Executive Director, Shell E&P

CWE Blueprint

The Global CWE Programme's common approach and methodology is embodied in the CWE Blueprint (Blueprint). The Blueprint is a shared "living" repository of knowledge and experience acquired and refined over the course of Shell E&P's own project implementations that also draw on the broader experience of its partners, vendors, and the E&P industry. By its very nature, the Blueprint is a work in process, continuously updated and published by the Global CWE Programme as a knowledge portal on Shell E&P's intranet. The Blueprint plays an important role in improving transparency of knowledge and experience across business units and assets. It also promotes standardization in approach and execution by providing business units and assets a shared management-level "field guide" to the implementation of CWEs through detailed, phase-by-phase, step-by-step guidance for planning, assessing, organizing, managing, designing, implementing, and operating CWEs in concert with Smart Fields initiatives.

The Blueprint includes:

- A comprehensive set of proven methods and best practices in the design and implementation of CWEs
- A summary of the organizational commitments and operational requirements for a CWE project
- Types and levels of resource commitments required throughout each phase of the CWE project
- Planning and budgeting templates
- The latest in experience-based key learnings and demonstrated success factors
- A framework for managing organizational change associated with a CWE project
- Global communities of experts and CWE practitioners
- Background and resource assistance from the Global CWE Programme
- A broad set of tools and resources to assist CWE project teams in project execution

The value in the global CWE approach is experience and access to expertise, contacts, and a tested methodology.
–Global CWE Programme Manager

Approach

In developing its approach to CWEs, Shell E&P recognized that enabling organizational change and addressing the human element of transformation required gaining the confidence and support of its business units and assets by demonstrating that its common approach and methodology offered tangible benefits for their CWE implementations. Several factors were essential to building these relationships and gaining momentum for the Global CWE Programme:

- Demonstrating that the approach and methodology provided a comprehensive and proven guide to achieving improved outcomes for CWE projects (compared to the business unit and/or asset's existing approach)
- Establishing that the Blueprint provided authoritative knowledge resources — a comprehensive methodology, current key learnings and best practices, practical tools and resources, and links to key contact information — reflecting Shell E&P's most recent implementation experience
- Ensuring that the Global CWE Programme was capable of providing the necessary implementation teams and experienced third-party resources to lead CWE project initiatives

Knowledge Management and Continuous Learning Initiative

In 2006, as part of its effort to meet these expectations, the Global CWE Programme launched a Knowledge Management and Continuous Learning (KMCL) initiative to incorporate knowledge capture and sharing as a core element of the common approach and methodology for Smart Fields and CWEs **(Fig. 1).** These practices are designed to ensure that the Blueprint provides business units an up-to-date, authoritative source of knowledge and experience as well as tools and resources developed through CWE implementations.

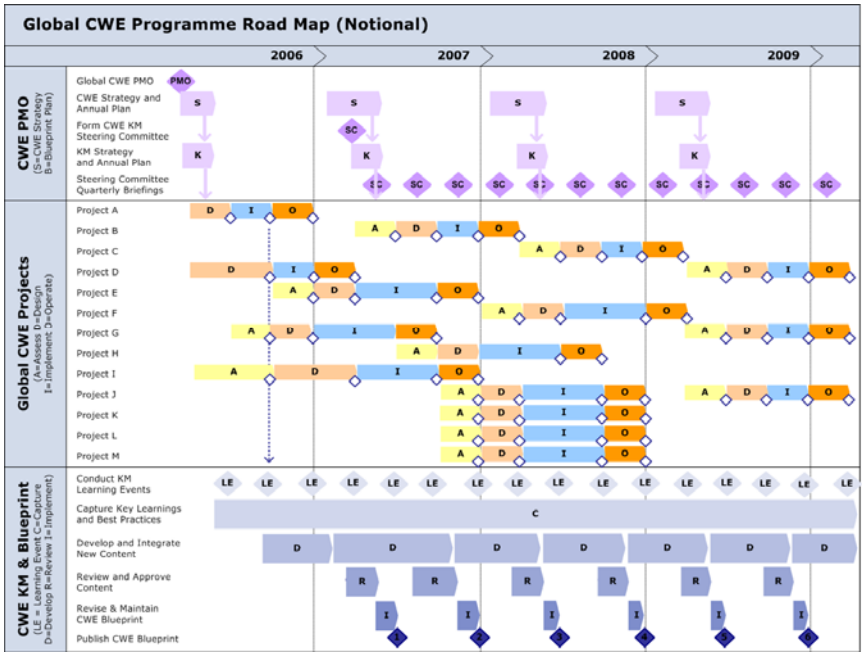

Fig. 1 — Global CWE Programme road map.

The stated goal of the KMCL initiative is as follows:

- Incorporate the fundamentals of knowledge management and continuous learning as core elements of the common approach and methodology to accelerate the capture, application, and sharing of knowledge and experience; improve and accelerate future CWE implementations; eliminate reinventing solutions to common issues; reduce errors related to recurring issues; and improve overall Smart Fields capabilities.

Objectives of the KMCL initiative are as follows:

- Establish and implement a set of methods and practices to capture, create, develop, update, and enhance the Blueprint by continuously incorporating key learnings and best practices from each CWE implementation.
- Establish and implement a set of methods and practices to promote the sharing, application, and reuse of key learnings and best practices from previous CWE implementations to improve future CWE project activity.
- Implement a common, shared Web-based resource to provide business units and assets with 24/7 access to Shell E&P's collective knowledge and experience in the design and implementation of CWEs and Smart Fields.
- Establish communities of practitioners focused on CWEs and Smart Fields to provide business units and assets expert resources and support teams to support future CWE project activity.

Shell E&P's approach to integrating knowledge management[9] and organizational learning[10] into Smart Fields is based on an established philosophy and methodology for continuous institutional learning.

Continuous Institutional Learning Approach

Shell E&P's approach to continuous institutional learning is composed of five elements:

- Team-based learning
- Communities of practitioners
- Knowledge assets
- Governance
- Enabling technologies

Team-Based Learning

The first element, team-based learning (i.e., learning before, learning during, and learning after an event), is a collaborative approach to continuous institutional learning **(Fig. 2)** in which project teams undertaking a CWE implementation benefit from the prior knowledge and experience of teams and individuals across Shell E&P.

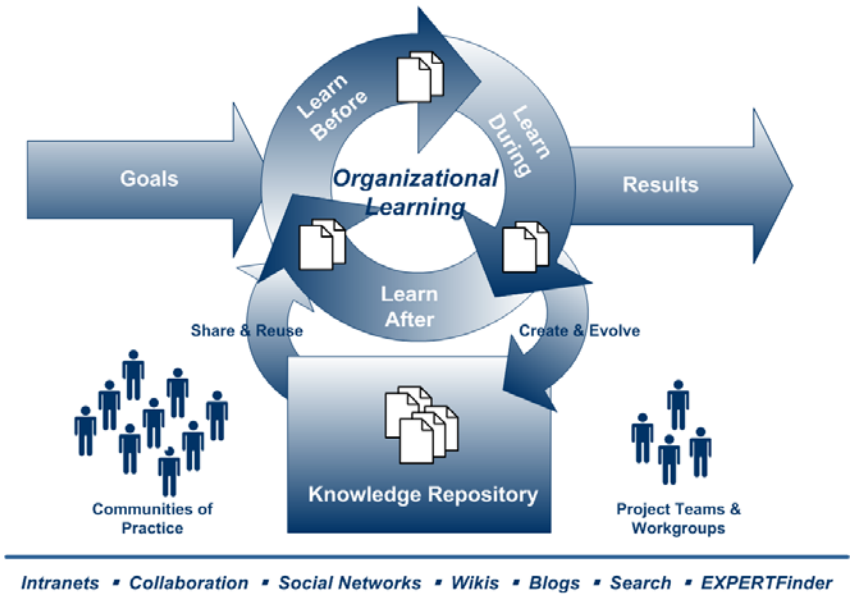

Fig. 2 — Continuous institutional learning model

Team-based learning uses a proven framework and a set of core activities **(Fig. 3).** It is supported by established tools, resources, and a community of peer practitioners who collectively review and refine Shell E&P's global best practices that are continuously codified and incorporated into future CWE project plans. There are three core learning activities:

- Peer Assist (Learning Before) — Peer Assists are supported through a process that targets a specific challenge (such as the approach to a new project phase), aggregates and integrates knowledge from people outside the core project team, identifies possible alternative approaches and new lines of inquiry, and promotes the sharing of learning among participants through a facilitated learning event and/or workshop.

- Action Review (Learning During) — An Action Review[11] is a rapid response technique (typically requiring no more than 15 minutes to use) designed to help people learn while doing by answering four key questions immediately after tasks are performed: What was supposed to happen? What actually happened? Why are they different? What can we learn and do about it now? Action Reviews are effective in team building, encouraging people to answer honestly, thereby building trust within the team, and immediately incorporating learnings to improve project delivery in real time.

- Retrospect (Learning After) — At the completion of a project, phase, or major milestone, a Retrospect encourages team members to "look back" and discover what went well and why, or what did not go as planned and how that might be avoided, with a view to helping a different team repeat their success and avoid pitfalls.

Learning activities are fully integrated and embedded in the CWE Blueprint approach and methods to ensure continuous, timely capture and incorporation of knowledge and experience. Peer Assists are conducted prior to the start of major work activities, and Retrospects are conducted at the completion of significant milestones. The 15-minute Action Reviews and one-on-one interviews of the team, partners, and/or Shell E&P users are conducted throughout the project execution cycle.

Each learning activity is designed to explore and elicit different types of discussion and feedback based on the specific audience (either an individual or group) and the project cycle phase. The structure of the activity can be fine-tuned to focus discussion and questions to address specific areas of interest.

Rationale	Peer Assist	Action Review	Retrospect
Who?	Between a team preparing to undertake new process and a group experienced in the same or similar processes	Among members of the project or task team	Between members of the actual project team with responsibility for overall performance of the task
What?	Interactive session facilitated by experienced peer assist facilitator Lessons learned are captured for process improvement	Short (15 minute) real-time review of a process or activity that focuses on capturing immediate learnings over a specific time period (day, shift or short-term activity)	Interactive session facilitated by experienced retrospect facilitator Lessons learned are collected and distilled
When?	Before a new project, phase or key activity	During a typical, repeatable task or activity.	Conducted at completion of a project, major phase or a key milestone
Why?	Suggests new approaches based on the experience of multiple peers. Yields more effective planning and execution, faster, cheaper and improved outcomes	Focus on improving performance during the next iteration of the same or similar process.	The team shares their experiences and identifies what worked well and not so well, in order to improve the process in the future

Fig. 3 — Team-based learning activities

Community of Practitioners

Communities of practice represent the second element that is essential to establishing and propagating a culture of continuous institutional learning. Communities represent groups of individuals with a shared interest or purpose who, as members of a group, realize benefits from collaborative knowledge sharing and problem solving in their personal and professional lives. In their simplest form, communities are informal and their membership grows among people who share common interests and who choose to participate. Ultimately, a community expands and multiplies as knowledge is shared, captured, distilled, and validated within the community, and individuals and groups take ownership and responsibility to maintain its integrity.

An informal community of practitioners exists within each CWE delivery team. By formalizing and expanding the informal community into one or more communities, the delivery team can leverage the collective intellect of Shell E&P's global expertise and resources **(Fig. 4).** Shell E&P is working to grow its communities of practitioners and to formalize and expand membership beyond the CWE delivery team to include strategic partners and the broader CWE user community. Active coaching and ongoing support will help these communities thrive and develop the skills necessary to transfer and codify their experience. For many, this is a new way of working, and continuous guidance and encouragement will help them quickly move up the learning and performance curve.

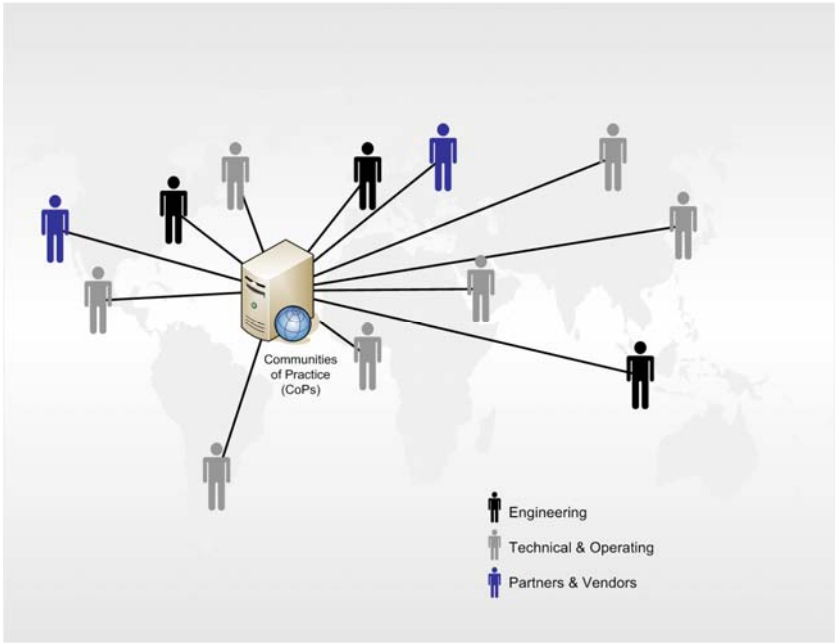

Fig. 4 — Global network of practitioners

The CWE architecture and technical standards embodied in the common approach and methodology play an important role in enabling and supporting communities of practitioners. CWEs are designed so that when they are brought online,

assets' environments can be linked to enable participation in a 24/7 network of CWEs, providing access to experts and expertise (both within Shell E&P and among its consultants and vendors) to address real-time issues and production events with the best information and resources available.

Knowledge Assets

At the heart of a sustainable culture of continuous institutional learning are knowledge assets, the third element of Shell E&P's approach to continuous institutional learning. These knowledge assets are composed of the portfolio of CWE-codified know-how and best practices embodied in the Blueprint and the tacit knowledge of individual experts and a global community of participants who are part of Smart Fields and CWEs. Widespread adoption of the Blueprint and the practices of a continuous learning culture across Shell E&P depend on the ability to continuously demonstrate that the body of knowledge and experience, as well as the tools and resources, are current, reliable, and authoritative.

While we are in the early stages of the Global CWE Programme, we are focused on and working towards this outcome by emphasizing three important objectives:

- Authoritative Source — Ensure that the Blueprint is recognized as the sole authorized source of aggregated and user-friendly content that is widely accessible to all users and that can be relied on to reflect the most up-to-date knowledge, tools, and resources.
- Continuous, Rapid Development — Establish practices and standards of performance that ensure content by rapidly identifying, eliciting, capturing, distilling, analyzing, aggregating, creating, contextualizing, reviewing, editing, managing, and ultimately retiring Shell E&P's body of knowledge and experience related to Smart Fields and CWEs.
- Participation and Ownership — Encourage individuals and communities of experts across Shell E&P to actively participate and take ownership of Shell E&P's body of knowledge and experience, and foster their involvement in providing, reviewing, sharing, and governing the processes and practices surrounding the Blueprint. By providing training and coaching, the global community of practitioners are encouraged to maintain knowledge assets as current, reliable, and authoritative.

Maintaining a current, reliable, and authoritative body of knowledge depends on having a systematic content development and management process incorporated as part of every CWE implementation. Each CWE implementation team includes representatives who are responsible for ensuring this process is administered and managed throughout each CWE implementation phase.[12]

The content development and management life cycle currently consists of five stages:

- Stage 1: Conduct Learning Events and Key Person Interviews — At the completion of each CWE implementation phase and as a first step to ensuring that the Blueprint is current and reliable, the CWE project conducts appropriate learning events and interviews, documents key findings and learnings, assesses best practices, and acquires any useful artifacts (e.g., tools, templates, or other resources). Based on the findings, a set of objectives are developed for updating the Blueprint.

- Stage 2: Themes, Messages, and Content Outline — Based on the findings of learning events and interviews, existing knowledge assets and artifacts are reviewed and specific revisions (e.g., additions, modifications, or deletions) are identified. Existing themes and key messages are revised where appropriate, and a revised content development outline is developed for the Blueprint.[13]

- Stage 3: Content Aggregation and Structuring — As appropriate, relevant supporting content and artifacts of the CWE project implementation are identified, aggregated, and integrated with the Blueprint content. As the body of knowledge expands, the Blueprint structure adapts to achieve maximum benefit from the available supporting content.

- Stage 4: Content Development and Review — Once the Blueprint outline is revised and supporting content acquired, the main content of the Blueprint is updated (e.g., created, updated, and revised, or deleted). To ensure that the updated Blueprint continues to provide relevant, reliable, and authoritative content, a formal review process consisting of the Global CWE Programme management and identified experts validate the changes and authorize release for publishing.

- Stage 5: Content Publishing and Feedback — The final stage in the Blueprint life cycle is the production and release of the revised Blueprint and knowledge asset through Shell E&P's intranet. In parallel with and throughout the knowledge life cycle, the Global CWE Programme solicits and monitors feedback from users and communities to ensure its objectives are being met and to identify opportunities to continuously improve the overall quality and value of the Blueprint.

It is important to emphasize that while the Blueprint life cycle follows a standard approach to ensure content is current, reliable, and authoritative, the timing of refreshing the Blueprint is important to achieving these outcomes. Today, the

Blueprint is nominally released every 6 months **(Fig. 5).** However, this semi-annual release does not restrict the Global CWE Programme from updating portions of the Blueprint more frequently. The Web-based Blueprint is published using a user-friendly Web development tool set, providing near-real-time ability to update the Blueprint as timely and relevant content becomes available from learning events, interviews, or other sources (e.g., industry conference proceedings). We are evaluating the potential of new tools that will enable real-time indexing of interview transcripts so that rich content can be distilled quickly and incorporated into the Blueprint. We also are exploring emergent technologies such as wikis and weblogs that can be integrated with the Blueprint to provide individuals and communities tools to create, capture, and share user-generated content in near–real-time. The principle that guides and governs how we manage the Blueprint life cycle is the ability to ensure current, reliable, and authoritative content for our business unit and asset clients.

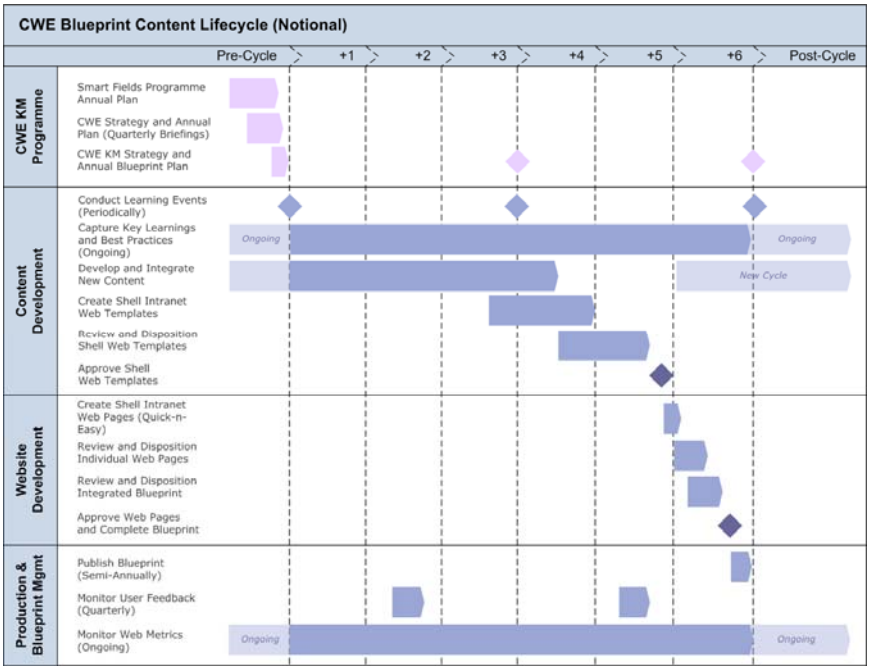

Fig. 5 — Notional Blueprint content development life cycle

Governance

Governance is the fourth element in establishing a sustainable culture of continuous institutional learning. By their very nature, knowledge assets are created and evolved from within the community of practitioners across Smart Fields and are widely shared and applied towards the common goal of accelerating and continuously improving CWE implementations and their outcomes. Governance requires a federated approach to place responsibility and accountability for the sustained success of the Blueprint (and knowledge asset) and the Global CWE Programme.[14]

To succeed in this goal and to sustain a culture of continuous learning, methods and practices for creating, capturing, transferring, and mobilizing knowledge must be aligned consistently with and focused on the goals and priorities of the business and its ability to continuously learn and adapt to a changing environment. This is the role of governance in the success of applying knowledge management and continuous learning to the Global CWE Programme.

Governance focuses on four priorities:

- Aligning — The Global CWE Programme works with the Smart Fields Programme to ensure its goals and objectives are fully aligned with, and in support of, the goals and priorities of Shell E&P and the Smart Fields business strategy and road map. The Global CWE Programme also collaborates and coordinates with business units and asset management teams to identify their needs and priorities as consumers of the Blueprint as the primary source of continuous learning for future CWE projects.
- Directing — Annually, the Global CWE Programme establishes a set of goals and objectives for the programme and the Blueprint. Those objectives are revisited and revised on a quarterly basis to ensure the efforts of CWE implementation teams and the KMCL initiative are focused on achieving the outcomes and providing the services necessary to promote and sustain the Blueprint as the single recognized source of knowledge and continuous learning for future CWE implementation.
- Enabling — As one of its key coordinating roles, the Global CWE Programme actively works to ensure its CWE implementation teams, partners, and vendors have the ability to perform to the maximum benefit of business units and assets in the implementation of CWE projects.
- Controlling — Monitoring the performance of the Global CWE Programme and its implementation teams by working closely with regional Smart Fields coordinators provides continuous feedback to ensure timely fine-

tuning of the programme and its activities and ensures the Blueprint and common approach continue to be recognized as the standard for CWE implementations.

The federated governance body that oversees the Blueprint and knowledge assets has representation from key stakeholders that have the ability to influence, and may be influenced by, the widespread initiatives to implement CWE across Shell E&P. The stakeholders that participate as part of the governance body include business units and assets that own identified CWE projects; the Global CWE Programme leadership team; the Smart Fields Programme leadership team; the KMCL team; supporting organizations, including IT, Human Resources (HR), and Procurement; and various partners and vendors.

Enabling Technologies

Enabling technologies constitute the final element of a sustainable continuous institutional learning culture. While institutional learning is not about technology, but rather about an organizational culture and philosophy, technology is clearly an important enabler. With the emergence of enterprise social computing, we believe technology increasingly will serve as an accelerator and proliferator of wider adoption across Shell E&P.

Today, the Blueprint leverages Shell E&P's existing intranet architecture and technology infrastructure:

- Shell's Wide Web — The Blueprint is accessible from any Web browser through Shell E&P's global intranet, making content widely accessible to any authorized user. All published content conforms to the guidelines established for Shell's intranet, as well as Shell's architecture and technical standards. The Blueprint enjoys the benefit of seamless integration with all the functionality of the Shell Wide Web, including search, user, and expert directories, indexes, and catalogues, among other valuable self-service features.
- Web Content Publishing — The Blueprint employs a highly user-centric, self-service Web publishing platform that enables rapid prototyping and publishing of updates to the Blueprint.
- Web Links — The Blueprint, in addition to its 75-plus pages of original content, serves as the central aggregation point for a variety of supplemental resources (e.g., authored papers and articles, presentations, spreadsheets, videos) and links to additional content sources inside (e.g., Smart Fields intranet) and outside of Shell.

The Global CWE Programme is exploring the potential for using other established technologies to enhance the Blueprint, making it an increasingly robust and rich source of knowledge, collaboration, and institutional learning:

- Wikis and Weblogs — Social computing technologies, including wikis and weblogs, are being piloted within Shell E&P to explore their increasing enterprise relevance and value. Wikis have the potential to enable teams and communities to document and share their collective knowledge with group context and purpose. Weblogs offer individuals the ability to engage in one-on-one conversations virtually with real-time feedback.
- Collaboration Technologies — Shell E&P uses various collaboration and team productivity applications and tools (e.g., team collaboration applications, document management systems, shared content repository) that may provide utility to implementation teams when linked with the Blueprint.
- Metadata and Search — With expanding content within the knowledge asset, application of standard taxonomies coupled with content tagging and power search capabilities can help users locate and access knowledge with greater relevance more quickly, thus enhancing both individual and team productivity and achieving better, faster, and more timely decision making.

In the future, emergent social computing technologies and integration frameworks (e.g., service-based architectures) have interesting potential to enhance user-driven, real-time collaboration and knowledge sharing and further promote and catalyse Shell E&P's continuous learning environment.

The Value of Continuous Learning

Applying knowledge management and organizational learning to accelerate and improve the implementation of CWEs has clearly demonstrated its value in the following ways:

- Faster Implementation — The continuous process of capturing and incorporating key learnings and best practices into each successive CWE implementation demonstrates that phases can be completed faster and with better outcomes.
- Faster Orientation and Indoctrination — The Blueprint provides an invaluable tool for new implementation team members who have limited time and resources available to get up to speed quickly
- Knowledge Sharing Across Shell E&P — Through the Blueprint, institutionalizing the practice of capturing and sharing knowledge and experience has been highly effective in reducing operational silos and creating more transparency in the access to knowledge resources.
- Standardization — The common approach established through the Blueprint introduces standardization across Shell E&P by adopting common architecture and technical standards, building a common taxonomy and

vocabulary, and enabling experts and practitioners to more effectively collaborate in problem solving and execution.

- Common Architecture and Technical Platform — Additional benefits of a common architecture and technical platform are the cost savings and economies of scale that Shell E&P will enjoy when CWEs located worldwide are linked and experts and practitioners are able to leverage the platform for a wide variety of uses beyond the implementation of CWEs.
- Effective Resource Management — Cumulative experience with CWE implementations at the granular level of individual phases has greatly expanded our understanding of when and where to use higher-priced global resources and when local resources can be best utilized.
- Efficient Allocation of Capital — While it is Shell E&P's goal to deploy smartness at all its production assets to an appropriate level based on life-cycle economics, our experience gives us practical knowledge of those key success factors that will allow us to ask the right questions, require the right commitments, and know when is the right time to move forward to achieve those outcomes.
- Integrated Delivery — CWEs are complex design challenges that require a highly experienced team of specialized expertise that can be assembled only through the integration of key personnel from within Shell E&P, our consultants and partners, and key vendors. Lessons learned from each CWE implementation have enabled us to continuously refine and improve our approach and practices for integrating these elements into highly effective teams that deliver better outcomes, at lower cost, with lessened impacts on our business unit and asset resources.

Following are some notable key learnings that underscore these valuable lessons.

We don't have to start from scratch; we've learned that there are common patterns of friction across the business units and that the commonality is greater than the differences. So for future CWE implementations, we already know the key questions to ask based on our experience.
–Global CWE Programme Manager

The value in the global CWE approach is experience and access to expertise, contacts, and a tested methodology.
–Global CWE Programme Manager

A common approach to designing and implementing collaborative work centres will ultimately enable one CWE to connect to another CWE.
–Smart Fields Technical Lead

Work processes are similar all over the world, so it's valuable to gather learnings from other CWE projects so you don't have to start from scratch. The Global CWE Programme provides a central source of global learnings and experience.
–Petroleum Production Technologist

The Global CWE Programme was created to provide business units with a standard approach and blueprint to speed implementation and enable individual CWEs to be connected seamlessly.
–Smart Fields Technical Lead

The Global CWE Programme's common approach to CWEs provides high reuse across Shell's businesses. Design building blocks apply across Shell's business areas and allow tailoring of CWE projects to meet the specific situation of each business unit. Technical designs are 60% to 70% reusable and designed for expandability to accommodate future changes without the expense of new technology.
–CWE Technical Consultant

The common approach to CWEs provides a flexible, adaptive methodology that enables it to facilitate many different types of collaborative initiatives.
–Smart Fields Technical Lead

Future Considerations

As stated previously, the approach to the design and implementation of CWEs throughout Shell E&P's global production assets is in a state of development. The goal is to advance and mature this process to the point at which the Global CWE Programme can confidently "commercialize" and "productize" the design and implementation of CWEs for release as a

core business practice within Shell E&P. To achieve this outcome, the Smart Fields Programme and Global CWE Programme will continue to focus on applying continuous organizational learning. Establishing continuous learning as a core building block of a successful Smart Fields and CWE operating model will require the Global CWE Programme to mature and evolve the Blueprint and CWEs beyond today's development environment within the Shell E&P R&D organization. To achieve this end result, the Global CWE Programme is pursuing several additional efforts:

- Refinement of the Blueprint — A primary driver in the adoption of the Blueprint methodology as the common approach for CWE implementations will be its ability to accelerate implementation, reduce costs, and deliver measurable improvement in production optimization and field recovery. The Global CWE Programme, through its continuous learning process and practices, continues to refine and improve the design and implementation process and actively promote the formation and integration of communities of practitioners with the other rich, robust tools and resources of the Blueprint.
- Enhanced Implementations — Beyond CWEs, lessons learned from the Global CWE Programme will be more widely applied to accelerating Smart Field implementation and maturation of the Smart Field operating environment. The fundamental principles and processes implicit in CWEs hold promise for applying them to other large-scale project initiatives, especially where the impact of organizational change is significant.
- Formation of Communities of Practitioners — As the Blueprint evolves within Shell E&P R&D and is released as a core business process of Shell E&P's operating organizations, communities of practitioners will emerge as critical agents of change and adoption. The Global CWE Programme already works closely with regional Smart Fields coordinators who are responsible for identifying and facilitating new Smart Fields and CWE projects within their regions. As Smart Fields projects are completed and field experience with design and implementation builds, our collective effort will continue to focus on fostering participation in these important loosely coupled informal organizations across Shell E&P. Communities are not only essential for sharing knowledge and experience and advising new project initiatives, they play an important leadership role in promoting and advancing a culture in which continuous organizational learning will thrive.
- Refinement of Learning Processes — The initial efforts to adapt and tailor methods and practices for capturing and sharing knowledge in an enterprise environment is now giving way to efforts to customize and enhance these methods within operational and cultural environments of Shell E&P. As business units and assets take ownership and begin to provide leadership for the emergence of a culture of teamwork and collaboration, primarily through established communities of practitioners, continuous organizational learning will emerge as the foundation of Smart Fields.
- Expansion of the Learning Processes — The learning process now focuses primarily on the implementation teams and the implementation of CWEs. In the future, as more CWEs go online, we anticipate an expanded focus of learning to include individual users within business units and assets that will provide increased relevance and utility to the resources of the Blueprint and knowledge asset. The integration of collaborative technologies and enterprise social computing will accelerate user-driven, user-defined learning and move towards the Blueprint as a real-time knowledge resource.
- Adoption of Enabling Technologies — As stated previously, opening the Blueprint to new and emergent technologies that have the potential to enhance knowledge capture and sharing, and to promote continuous real-time learning, is being conducted within Shell E&P today and remains an exciting frontier for the application of knowledge and learning in the future.

Finally, the Global CWE Programme will continue to apply its approach to knowledge management and continuous learning to support priorities of the Smart Fields Programme and Shell E&P's global business strategy and road map.

The common approach to CWEs provides a flexible, adaptive methodology that enables it to facilitate many different types of collaborative initiatives.
–Smart Fields Technical Lead

Conclusion

Shell E&P is responding to industry trends by rethinking traditional operating models and adopting innovative ways of working that will enable it to optimize the development and production of oil and gas assets. By capturing and sharing among its global workforce the knowledge and experience with implementing smart technologies, redesigning business processes, and designing specialized collaborative facilities, Shell E&P is reshaping its operating model while shaping a culture of collaboration and teamwork built on trust, knowledge sharing, and continuous learning.

Endnotes

[1] Smart Fields is a registered trademark of Shell
[2] Foundation technologies include data acquisition and control architecture; real-time production monitoring; integrated production system modelling; real-time operations applications and production data management; and a common IT architecture promoting rapid, low-cost, global smart capabilities integration.
[3] The concept of Smart Fields centres on the "value loop," the data-model-decisions-execution cycle that drives value in the asset. The cycle is composed of four core business process steps: data acquisition, interpretation and modelling, options generation and decision making, and execution in the asset.
[4] Implementation of foundation technologies and collaborative work environments requires a high degree of coordination and teamwork. The Smart Fields Programme uses a federated approach to governance. Field and staff organizations work through a leadership council represented by the E&P organization, individual regions and assets, and technical and production leadership teams. An extended stakeholder body of representatives from operational units throughout Shell E&P also participates as required to ensure broad support.
[5] In the case of greenfields, smartness will be "built in" as an element of design; existing brownfields will adopt smartness based on economic viability over the remaining field life expectancy.
[6] As an R&D organization, Smart Fields and the Global CWE Programme are responsible for performing the research and investigation for purposes of commercializing new technologies that advance Shell E&P's strategic and operational goals and objectives. Ultimately, responsibility for Smart Fields and CWEs will transfer to the regional assets when both are sufficiently matured and productized, so that implementations can be repeated and business units and assets can self-direct deployment of these technologies.
[7] The Global CWE Programme implementation teams are resourced by Shell E&P's Smart Fields Programme staff and experienced industry consultants and vendors who specialize in the design of work processes, selection of collaboration technologies and design of collaboration facilities, and the process of managing organizational change that results from adopting new operating practices. All consultant and vendor services are provided through the Global CWE Programme subject to pre-negotiated agreements and rate schedules.
[8] Other digital oilfield initiatives are being pursued by E&P operators and suppliers, including British Petroleum, Chevron, Saudi Aramco, Statoil, ConocoPhillips, Norsk Hydro, PEMEX, ENI, Petrobras, ONGC, and Maersk.
[9] Knowledge management, as used here, is associated with three types of activities: facilitating human collaboration and the sharing of knowledge; documenting and appropriating individuals' tacit knowledge and distilling and disseminating it to others in a meaningful, reusable way; accelerating project initiatives; and improving the instance of individual knowledge through involvement and minds of others.
[10] Continuous learning implies the methods and practices through which an organization actively creates, captures, transfers, and mobilizes knowledge as necessary to enable it to continuously learn and adapt to a changing environment. Thus, the key aspect of organizational learning is the interaction that takes place among individuals involved in acquiring, analyzing, decision making, and execution.
[11] Action Reviews are modelled after methods developed by the U.S. Army called After Action Reviews.
[12] A key success factor worth pointing out here is that the content development and management process is focused on the human element; technology is an enabler. This underscores a distinction with respect to the application of the principles of knowledge management and organizational learning that is embedded in the Global CWE Programme. Ideally, knowledge and experience, and the tools and resources to capture, share, and apply it effectively, are user-defined, user-driven, and user-engineered. A number of emergent technologies are maturing, and some may evolve into proven business solutions that strengthen Shell E&P's ability to manage knowledge and enrich institutional learning. However, our common approach continues to recognize the importance of focusing on the human element in the capture, sharing, and application of knowledge to continuously improve Shell E&P's strategic priorities of production optimization and resource recovery.
[13] Note that the scope of revisions to the Blueprint will vary significantly depending on the scope of the learning events. Typically, a Peer Assist or Action Review has minor influence on the Blueprint, but has more significant influence on the CWE project plan or specific approach as tailored to each individual asset. In contrast, a Retrospect is more likely to influence the Blueprint, whether contributing to an expanding inventory of key learnings, suggesting modification to the existing methods to incorporate best practices, or making new and relevant content sources available through the knowledge asset.
[14] In the federated governance model used here, the centrally coordinated Global CWE Programme shares responsibility and accountability with regional business units and assets for the successful outcome of designing and implementing CWEs. Federated governance models are based on common goals and objectives, shared outcomes, and shared ownership of the knowledge, tools, and resources that enable those outcomes to be achieved. By working together and presenting a single face to all organizations, the governance body provides common, shared leadership on behalf of the Smart Fields Programme.