Design and Practice of Digital Publishing Workflow Reengineering: A Case Study of the Digital Science and Technology Manual Project (Postprint)

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Abstract

With the digital wave sweeping across various technological fields and the trend of integrated development in the publishing industry, the publication of scientific and technical handbooks that still primarily rely on paper-based carriers faces numerous challenges. Using the Digital Scientific and Technical Handbook Project of China Machine Press as a case study, this paper elaborates on how digital transformation of publishing processes can realize diversification of product forms and digitalization of publishing workflows for scientific and technical handbook publications, thereby optimizing user experience and enhancing market competitiveness.

Full Text

Design and Practice of Digital Publishing Process Reengineering: A Case Study of the Digital Science and Technology Handbook Project

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Abstract: With the digital wave sweeping across scientific fields and the publishing industry trending toward integrated development, science and technology handbook publishing—still primarily paper-based—faces numerous challenges. Taking China Machine Press' s digital science and technology handbook project as an example, this paper elaborates on how digital publishing process reengineering can diversify product forms and digitalize publishing workflows for scientific reference books, thereby optimizing user experience and enhancing market competitiveness.

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As the digital transformation and upgrading of traditional publishing deepens, with widespread application of artificial intelligence, VR/AR, big data, cloud computing, 5G, and other emerging technologies, users increasingly demand timeliness and superior experiences from content products. This has driven digital publishing products to become more diverse in form, with shorter publication cycles and stronger demand for print-digital synchronization. Traditional publishing business processes built around paper publications can no longer meet the needs of increasingly diverse business scenarios in the integrated development of traditional and digital publishing. Therefore, exploring how to digitally reengineer traditional publishing processes holds significant importance.[1]

1.1.3 Practicality

China Machine Press's various handbook publications provide professional readers with fundamental data, commonly used materials, methods, technical parameters, typical structures, design calculation examples, and other content, primarily presented through figures and tables to ensure comprehensive, practical, and convenient information that quickly solves practical problems in professional work.

1.2 Challenges for Science and Technology Handbook Publishing in the Digital Wave

In recent years, as digitalization sweeps across scientific fields and the publishing industry moves toward integrated development, science and technology handbooks still primarily in paper format face numerous challenges.

1.2.1 Limited Knowledge Capacity of Paper Handbooks The knowledge required for a particular specialty often transcends disciplinary boundaries. As interdisciplinary integration becomes increasingly common, relying solely on paper books to meet readers' comprehensive knowledge needs is difficult. Particularly due to space limitations, typical and cutting-edge cases that readers need are often insufficiently provided, leaving readers feeling that content lacks comprehensiveness and practicality.

1.2.2 Inconvenient Usage of Paper Handbooks Paper handbooks are becoming increasingly lengthy, with more volumes, making content retrieval time-consuming and portability inconvenient. Although some paper handbooks were previously equipped with digital versions, most were distributed via CD-ROMs or standalone software, which were troublesome to install and update, did not support mobile devices, and offered insufficient intelligence for table queries and formula calculations.

1.2.3 Overly Long and Difficult Publication Cycles Large-scale handbooks involve author teams ranging from dozens to hundreds of experts, typically comprising academicians, professors, and senior engineers from universities, research institutes, and enterprises. The organizational and publishing workload is heavy, resulting in long compilation periods. Updating and revision are extremely difficult, with some handbooks unable to be revised after initial publication. Consequently, traditional publication speeds lag far behind the current pace of knowledge iteration.

1.2.4 Increasing Pricing As costs for author fees, paper, and printing increase, handbook prices continue to rise, often reaching thousands of yuan, which inadvertently raises the barrier to purchase.

1.2.6 Changing Reader Access Channels With the widespread use of digital literature databases such as CNKI, Wanfang, and VIP, as well as industry auxiliary design tools, readers increasingly prefer digital means to retrieve and access professional content. Compared with traditional paper handbooks, literature databases offer advantages in practicality, convenience, rich content, and cost-effectiveness, posing significant challenges to traditional paper handbook publishing.

2.1 Diversified Product Forms

Digital publishing process reengineering aims to support diversified content product forms. The new science and technology handbook publications primarily include the following product forms:

2.1.1 Paper-Digital Fusion Handbooks This remains a paper publication format, but links to various digital resources through QR codes and AR technology. The main digital resources include table queries, formula calculations, typical cases, color stereograms, 3D simulation resources, video courses, PPT courseware, knowledge maps, and other knowledge expansions and associations (standards, e-books, articles, etc.). These digital resources are also connected to online digital handbook products. The paper handbook becomes thinner overall, with reduced prices.

2.1.2 Online Digital Handbooks The knowledge system of the digital handbook still follows the structure of the paper handbook, but its content has been substantially expanded and supplemented, with regular updates possible. Content is primarily organized as chapter entries and resource toolsets, accessible via web platforms and mobile apps. Users can perform full-text searches and complex conditional searches. Charts and formulas are provided as online digital tools, supplemented with extensive cases, videos, standards, simulation experiment tools, and other expanded content. Entries, resources, and tools are connected through the knowledge system, enabling readers to conveniently access content and use tools anytime and anywhere, significantly improving productivity. Digital handbooks can be sold separately from paper versions through user licensing or bundled with paper handbooks at a lower price.

2.1.4 Mainstream E-book Formats This includes mainstream e-book formats such as EPUB, PDF, and Mobi, available in both reflowable and fixed-layout versions, supporting full-text search and content copying.[3]

After fragmenting the massive, detailed, and authoritative industry content resources in handbook-type books, relatively independent knowledge units are formed. Through multi-dimensional indexing and association, these knowledge units form a networked industry knowledge graph, ultimately composing an industry encyclopedia database product. The difference between the encyclopedia database and the digital handbook is that the former no longer has the concept of a "book" but consists of relatively independent yet interconnected knowledge units. The granularity of knowledge unit segmentation is finer than chapter entries, with more complete metadata, enabling free expansion and knowledge mining and discovery, representing a more advanced form of knowledge service.

2.2 Digital Process Reengineering Scheme

The overall design principle for the new publishing process is: one-time design, multi-format release; one process, print-digital synchronization; one team, collaborative division of labor. The process diagram is as follows:

The main stages of the entire process are completed within the "Science and Technology Handbook Integrated Publishing Platform" (hereinafter referred to as "the Platform") developed by China Machine Press. First, handbook authors establish the volume-chapter structure in the Platform and collaboratively write and upload content. After the publisher compiles and proofreads the manuscript, industry experts, editors, and product managers determine the content digitalization plan (i.e., which content parts to digitize and the digital presentation format), while technical personnel determine the technical standards for processing and development. The preliminary finalized handbook content files, digitalization plan, and relevant standards are then packaged and outsourced for development. The outsourcing stage requires one or two comprehensively capable companies to assist with paper handbook typesetting, digital resource and tool development, QR code and AR resource linking, e-book processing,

and other tasks. Throughout outsourcing, publisher authors, editors, and product managers must participate fully, collaborate closely, and conduct repeated testing to ensure development progress, functional rationality, and scientific accuracy. Finally, the publisher uses different process tools to simultaneously convert the finalized manuscript (after three-review and three-proofreading) into four predetermined product forms:

1. Generate print-ready PDF files with embedded QR codes and AR functionality for delivery to printing houses, creating paper-digital fusion handbooks;
2. Convert into XML files containing chapter entries, digital resources, and tool access links, which are uploaded to the Platform for automatic parsing and release, forming online digital handbook products;
3. Based on the foundational XML files, conduct further segmentation and indexing to break away from the handbook concept, splitting into fine-grained knowledge units that form a networked industry knowledge graph through associations, ultimately creating an industry encyclopedia database product;
4. Process the XML files into multiple mainstream e-book formats such as EPUB, PDF, Mobi, and OCF for multi-channel distribution.

The new process considers the requirements of all four product forms from the initial design stage. Implementation uses one workflow to simultaneously output four product forms. The entire process forms a tight-knit team comprising authors, publisher editors, product managers, and outsourcing company developers. Through continuous collaboration, the publisher and outsourcing companies gradually establish 默契的合作关系 (tacit cooperative relationships), theoretically achieving disruptive improvements over traditional processes.

3. Practice of Science and Technology Handbook Digital Publishing Process Reengineering

The digital handbook project team at China Machine Press comprehensively considered market demand, competitor situations, content types, author willingness, compilation progress, and other factors to select five handbooks for piloting the new process: *Mechanical Engineering Handbook*, *Electrical Engineering Handbook*, *New Hardware Handbook*, *Manufacturing Quality Inspector Handbook*, and *Mechanical Designer' s Handbook* (Volumes 1 & 2, 3rd Edition). Practice has revealed the following advantages:

The new process achieves true print-digital synchronous integrated publishing, changing the previous print-first-digital-later workflow and enabling rapid development and release of all product forms. Authors collaborate through an online co-editing system with the entire process completed in the cloud, strengthening version management, reducing communication costs, and significantly shortening compilation cycles. The streamlined process concentrates paper typesetting, resource and tool development, e-book processing, and entry segmentation

within one or two outsourcing companies, substantially reducing coordination time costs and greatly improving team efficiency and product quality stability. Paper handbooks become thinner while content increases, costs decrease, pricing drops, and market competitiveness strengthens. Handbooks published through the new process feature novel and diverse forms, richer content, and more practical functions, receiving positive market feedback. For example, the electromechanical engineering encyclopedia database product developed based on the *Mechanical Engineering Handbook* and *Electrical Engineering Handbook* was selected as a sub-project in the 2020 National Press and Publication Administration' s Digital Publishing Excellence Selection Program, as shown in the figure below:

[FIGURE:N]

4. Key Issues Requiring Attention in Practice

The process reengineering practice has revealed several critical issues:

4.1 Coordination with Outsourcing Companies

The new publishing process imposes high requirements on outsourcing companies. It is generally difficult to find a single company that simultaneously understands both publishing and the industry, excels at content typesetting and data processing, and can develop various digital resources. Therefore, publishers need to establish long-term, stable cooperative relationships with one or two relatively comprehensive and potentially capable companies, assisting them in gradually improving their capabilities during process reengineering. Through continuous close collaboration, all tasks can be completed. In theory, the new process represents a disruptive improvement over traditional processes.

4.2 Cultivation of Design Capabilities

Traditional authors and editors are often industry experts with extensive paper handbook experience but lack digital product design capabilities, making them somewhat inadequate for the new digital handbook publishing process. Therefore, it is necessary to change their fixed mindsets regarding paper products, strengthen cultivation of digital product design capabilities and project management skills oriented toward digital publishing, and evolve them into integrated authors and editors who meet digital publishing requirements.

4.3 Reorganization of Internal Processes

Since the new handbook publishing process represents a disruptive change to traditional publishing—merging multiple business processes for different product forms into one unified workflow involving numerous departments and significant changes—it is essential to carefully reorganize internal processes such as approval and settlement, coordinate communication among relevant internal

departments, and implement corresponding modifications to ERP and other management systems to ensure smooth workflow transition.

4.4 Establishment of Collaboration Mechanisms

Since the entire implementation process requires full participation from authors and editors, it is necessary to establish a comprehensive collaboration mechanism among authors, editors, and outsourcing companies, making full use of online digital communication tools to ensure smooth coordination, adequate understanding of requirements, and alignment of objectives.[4]

Digital publishing process reengineering for science and technology handbooks is an inevitable response to challenges such as declining paper handbook sales and changing reader habits. Practice has proven that the reengineered process achieves expected results and provides a reference for digital transformation of other book types. The new process still has shortcomings requiring continuous optimization and adjustment according to evolving business needs to adapt to the developing integrated publishing model.

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Note: Figure translations are in progress. See original paper for figures.