

Criterion of "Print 4.0" smartification level: Hong Kong Print 4.0 Maturity Model

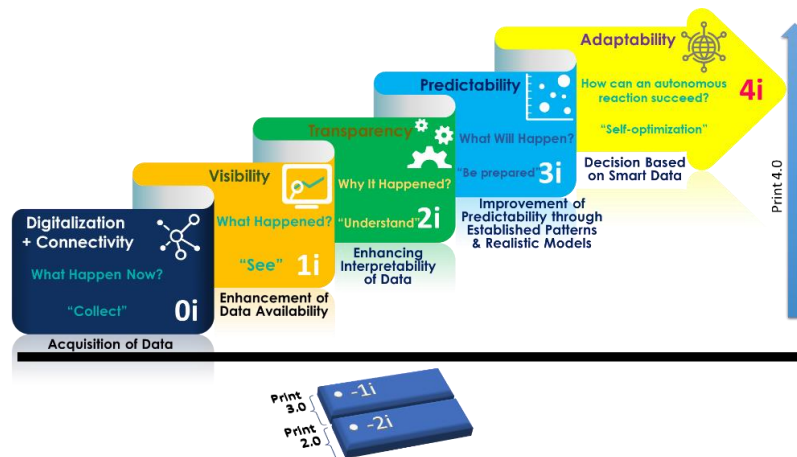
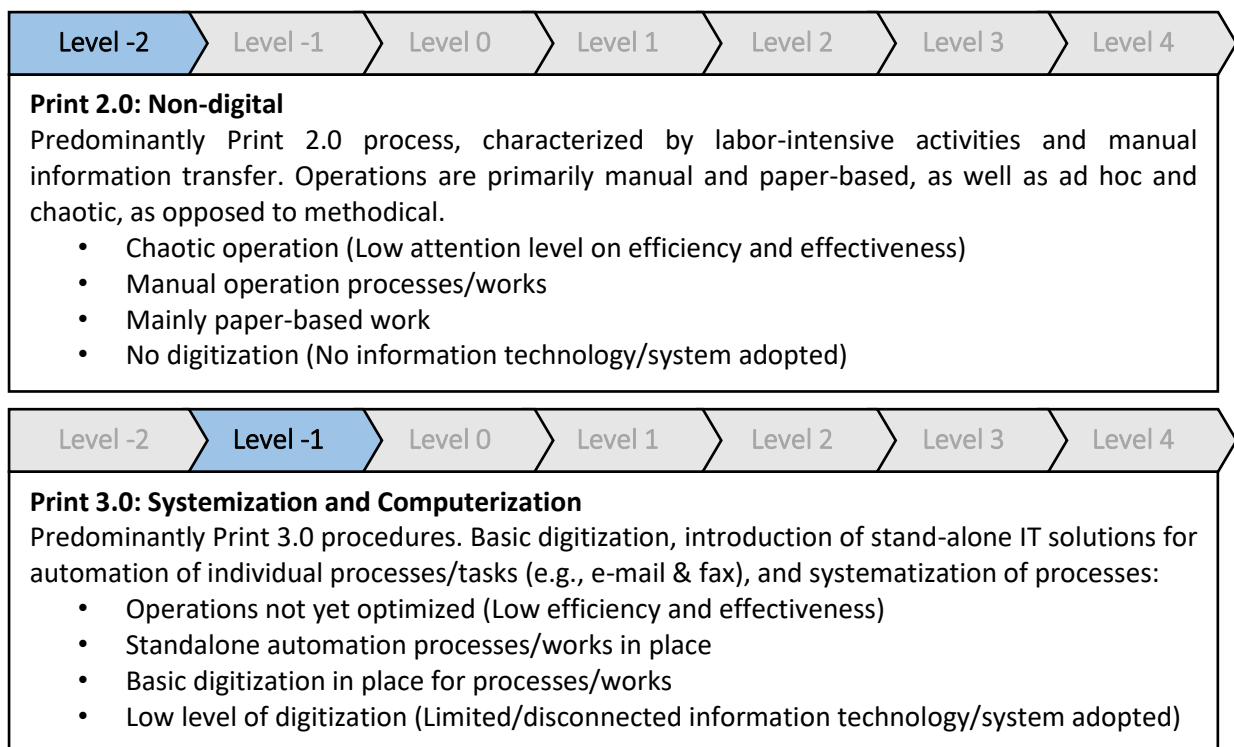


Figure 1: Maturity Levels

The transition towards Print 4.0 at each individual level provides businesses with additional value and a competitive edge. For ensuring capabilities growth sustainably, every change among levels should be introduced gradually and uniformly across all departments, instead of jumping suddenly. It is worth noting that solutions up to level 2i are currently available, cost-effective, and appropriate for industrial application. However, solutions from levels 3 and 4 are still under development and require enhanced computing power, a high-performance IT infrastructure, and access to high-quality big data from multiple sources. Consequently, they are only viable and cost-effective for technologically advanced businesses.



Level -2

Level -1

Level 0

Level 1

Level 2

Level 3

Level 4

Print 4.0: Connectivity - Foundation Condition

Organizational and infrastructural enablers for the deployment of Print 4.0. Interconnection of internal IT systems without media interruptions affecting the direction of information flow:

- Print 4.0 awareness and culture built
- LEAN processes & reasonable networked automation
- IT-infrastructure and data security
- Data acquisition by sensor and IoT in real time for processes/works
- Standalone advanced digital tools adopted & mastered

Level -2

Level -1

Level 0

Level 1

Level 2

Level 3

Level 4

Print 4.0: Visibility - “What is happening?”

Real-time generation and availability of data and information for all actions. Effortless flow of information in all directions between internal and external information sources and IT systems, resulting in a "single source of truth" and transparency across all processes and activities:

- Vertical integration of advanced digital tools (e.g., MES, QMS, WMS)
- Delivery management, Track and Trace
- Well established “Single Source of Truth”
- Real time end-to-end printing process visualization
- Use of data for basic operation analysis (descriptive)

Level -2

Level -1

Level 0

Level 1

Level 2

Level 3

Level 4

Print 4.0: Transparency - “Why does it happen?”

Through the study and compilation of all accessible information and data sources, knowledge and insights are created. Complete aggregation of internal and external real-time data to determine the cause-and-effect links between events and their root cause:

- Full digitalization & aggregation of real time data including EDI/APIs and IoT platform
- Collaboration within organization and agile management (e.g., planning/forecast ability & decision making, improvement)
- Smart Data analytics and machine learning adopted & mastered

Level -2

Level -1

Level 0

Level 1

Level 2

Level 3

Level 4

Print 4.0: Predictability - “What will happen?”

For decentralized decision-making, predictive analytics and human-system / system-system collaboration are essential. Application of simulation models, which are based on actual historical data and are continuously refined, in order to anticipate the likely outcomes of certain events or decisions:

- Decentralized decision-making
- HMI/MMI, Industrial apps
- Mobile assistance systems
- Close-loop process optimization over the whole production process and predictive analytics

Level -2

Level -1

Level 0

Level 1

Level 2

Level 3

Level 4

Print 4.0: Adaptability - “How can an autonomous reaction succeed?”

Along the value chain, self-optimizing processes and autonomous control of processes. Addition of an automatic and autonomous evaluation function that can make a determination regarding which event or choice will result in the greatest possible outcome for the company and its customers:

- Autonomous automation
- Self-learning, self-organizing and self-optimization