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Preface of the publisher

28th Journal für Facility Management: Science meets Practice

In the last years the EU published the Corporate sustainability reporting directive (CSRD) which enlarged the number of companies subject to reporting obligations and the scope of reporting on sustainability aspects. In addition, the ESRS defined the way and the content of reporting standards in an extended way. In order to strengthen the EU's competitiveness and reduce bureaucratic obligations the Omnibus was published in spring this year. It is to remove at least 80% of companies from the scope and simplify reporting requirements for large companies through a revision of the European Sustainability Reporting Standards (ESRS). This reduces the effort for sustainable reporting and actions to a high extend. On the other hand, other regulations like the Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency are still in place and ask for more efficiency and optimisation. Therefore, sustainability as a topic has still high importance for the real estate sector. To provide research-based answers how we can cover the requirements and even create added value this issue of the IFM journal includes the following papers:

- How does FM contribute to the social dimension of ESG?
- Data Envelopment Analysis for Sustainable Healthcare: Ranking Hospitals based on CO_2 Emissions; Desirable/Undesirable Output
- New version of the Building Efficiency Directive 2024: Current developments and implications for the future management of buildings
- High-Performance Climbing Plants for Urban Climate Improvement: Maintenance Strategies for Climbing Plants in Vertical Greening Systems

The first paper investigates how Danish FM companies and professionals manage the challenge to develop social sustainability practices and measure the social dimension of ESG. It presents a literature review on social sustainability and the results of a survey among Danish FM practitioners. The paper gives suggestions to practitioners to work with social sustainability and measuring the social dimension of ESG.

The second paper presents the data envelopment analysis (DEA) as a widely used tool for performance measurement tool in healthcare due to its flexibility in handling multiple inputs and outputs, including both desirable and undesirable factors. This study applies a customized DEA model to evaluate the performance of hospitals. The results highlight the potential of DEA in addressing current challenges in healthcare performance management.

The third paper deals with the Energy Performance of Buildings Directive (version 2024), which defines the "smart readiness" of buildings and asks for a renovation passport including a renovation roadmap for buildings. This directive is in line with the European Sustainability Reporting Standards (ESRS) and points out the synergy effects in terms of data collection, evaluation and utilisation. Adapting processes can generate added value and reduce additional costs.

The fourth paper is more practically orientated. Vertical Greening Systems (VGS) in urban areas play a crucial role in urban climate adaptation, energy efficiency, and biodiversity, but their sustaining benefits depend on species-specific care and maintenance. Tailored interventions from planting through preservation maintenance are essential to optimise Plant Coverage (PC) and Wall Leaf Area Index (WLAI), enabling effective cooling and bioshading that directly impact these ecosystem services. The paper delivers practical recommendations and checklists for the sustainable management of VGS, providing a practical framework for building owners, planners, and facility managers to maximise environmental, economic, and aesthetic benefits.

At this point, I want to thank all international researchers who sent us numerous abstracts and papers for the double-blind review. The decline rate was kept high. I also want to thank the members of the editorial and the scientific board for their terrific work. They supported me in reviewing first the abstracts and then the full papers and gave a lot of input to the authors. The high decline rate, the high reputed members of the editorial and the scientific board and the supporting universities ensure that the articles are not only highly scientifically qualified, but also that practitioners can put them into practice easily. I also want to thank my team, especially Barbara Gurdet and Elisabeth Morillo-Napetschnig. Without their personal engagement the journal would not be available in this high quality.

I wish you all the best from Vienna, an enjoyable read, a lot of input for your research and/or for your daily work. I look forward to new striking research in the next IFM Journal and a refreshing exchange at the 19th IFM Congress 2026.

Your
Alexander Redlein
Head of Editorial Board

To my family Barbara, Caroline Sidonie und Alexander David

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47 Mapping workplace characteristics against a backdrop of hybrid work life – An explorative comparison between office workplaces & home workplaces

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Science meets Practice:
ESG and its Implementation

Zipp & Scan – Eine innovative Lösung zur Optimierung des Effektenhandlings im Krankenhaus

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Abstract:

Der Transport und die Verwaltung von Patienteneigentum in Krankenhäusern gewinnt zunehmend an Bedeutung aufgrund von Veränderungen in den primären Prozessabläufen, bei denen die Aufnahme von Patient:innen ins Krankenhaus und ein chirurgischer Eingriff für denselben Tag geplant sind („Same Day Surgery"). Traditionell werden getrennte logistische Prozesse durchgeführt, die Dokumentation der Patientensachen erfolgt oft auf Papier, und es ist eine geringe Patientenzufriedenheit durch Wartezeiten, verlegte oder sogar verlorene Effekten zu beobachten. Diese explorative Studie evaluiert Zipp & Scan, eine innovative Lösung, die von der Zippsafe AG entwickelt wurde, um das Management von Patienteneigentum in Same Day Surgery Prozessen zu verbessern. Das Projekt bewertet die Auswirkungen der Kombination aus einer Dokumentations-App und einer speziell entwickelten Transport- und Aufbewahrungstasche am Krankenbett auf die Prozesseffizienz, die Nutzerzufriedenheit und die Reduzierung von Verlusten im Vergleich zu herkömmlichen Methoden im Kantonsspital Baden, Schweiz. Es wurde ein Multiple-Methods-Ansatz gewählt, der quantitative Datenerhebung mit qualitativen Erkenntnissen kombiniert. Die Ergebnisse der Studie zeigen eine Zeitersparnis, eine höhere Zufriedenheit der Beteiligten und eine Verringerung der finanziellen Verluste aufgrund von verlorenen Gegenständen. Sie bildet dabei einen Beitrag zur Digitalisierung im Gesundheitswesen und ist Referenz für die Einführung eines App-gestützten, nutzendenfreundlichen und effizienzorientieren Transportsystems für weitere Spitäler.

Keywords:

Same Day Surgery, Gesundheitswesen, Prozessoptimierung, Effektenhandling/-management, Digitalisierung

Abstract English:

The transport and management of patient belongings in hospitals becomes more important due to changes in the primary process settings, where patient's admission to the hospital and a surgical intervention are planned for the same day ("same-day surgery"). Traditionally, separate logistic processes are performed, often the documentation of patient's belongings is paper based, and low patient's satisfaction through waiting times, misplaced belongings or even loss can be observed. This exploratory study evaluates Zipp & Scan, an innovative solution designed by Zippsafe AG to improve patient belongings management in same-day surgery settings. The project assesses the impact of the combination of a documentation app and a specially designed bedside transportation and storage bag on process efficiency, user satisfaction, and loss reduction compared to traditional methods at Cantonal Hospital Baden, Switzerland. A multi-methods approach was adopted, combining quantitative data collection with qualitative insights. Results of the study show time savings, increased stakeholder satisfaction, and reduced financial losses due to lost belongings.

Keywords:

Same Day Surgery, Healthcare, Process optimization, Digitalization

1. Einführung

Die effiziente Handhabung von Patienteneigentum ist ein wichtiger, aber oft vernachlässigter Aspekt in der Krankenhauslogistik, insbesondere bei Patient:innen der Chirurgie, die zunehmend erst am Tag der Operation als «same-day-surgery»-Patient:innen im Krankenhaus aufgenommen werden (SDS). Herkömmliche Methoden wie die Lagerung des Gepäcks in Transportboxen oder Plastiktaschen, eine oft papierbasierte Dokumentation, aber auch die Zwischenlagerung und Logistik mittels mobiler Patientenschränke erfordern eigene Transportprozesse, sind arbeitsintensiv und fehleranfällig, was zu Unzufriedenheit sowohl bei den Patient:innen als auch beim

medizinischen Personal führt (Diez et al., 2025; Taylor, 2019; Williams et al., 2003). Geht Patienteneigentum dabei verloren, führt dies nicht nur zu finanziellen Verlusten aufgrund von Kulanzzahlungen, sondern auch zu vermindertem Vertrauen der Patient:innen (Zippsafe, n.d.).

Am Kantonsspital Baden (KSB) in der Schweiz wurde daher ein neues System als Pilot eingeführt, die Anwendung von Zipp & Scan, eine Kombination aus einer mobilen App (ZippScan) und einer bettseitigen Aufbewahrung (ZippBag), so dass Gepäck und Patient:innen gemeinsam transportiert werden. In dieser Studie werden der neue Pilotprozess und der Standard-Gepäckprozess am KSB mittels Kunststoffboxen und Gepäckabholdienst über einen Zeitraum von 3 Wochen vergleichend untersucht. Ziel dabei ist, evidenzbasierte Erkenntnisse über die Wirksamkeit des Systems bei der Rationalisierung von Abläufen und der Steigerung der Zufriedenheit zu gewinnen. Dazu sollen folgende Forschungsfragen beantwortet werden:

1. Wie gross ist die Ersparnis benötigter Arbeitszeit der am Prozess beteiligten Spi-talmitarbeitenden von Zipp&Scan im Pilotprozess gegenüber dem bisherigen SDS-Standardprozess mit Transport in Kunststoffboxen und Gepäckabholdienst?

2. In welchem Umfang unterscheidet sich die Zufriedenheit mit dem Zipp&Scan-Pilotprozess vom bisherigen SDS-Standardprozess mit Kunststoffboxen und Gepäckabholdienst für die beteiligten Pflegepersonen?

3. In welchem Umfang wird Zipp&Scan dem bisherigen SDS-Standardprozess mit Kunststoffboxen und Gepäckabholdienst durch Patient:innen bevorzugt?

4. Kann ein Unterschied bei der Anzahl sowie den Geldwerten von Verlusten von Patienteneffekten und zugehörige Kulanzzahlungen zwischen dem bisherigen SDS-Standardprozess mit Kunststoffboxen und Gepäckabholdienst und dem neuen Zipp&Scan-Prozess festgestellt werden, und wenn ja in welchem Umfang?

2. Vorgehen und Methodik

Vor dem Hintergrund eines Projekts der angewandten Forschung spielt die Wahl der Methoden eine zentrale Rolle für die Richtigkeit, Nachvollziehbarkeit und Verwertbarkeit der Ergebnisse. Es ist daher eine systematische Vorgehensweise von

Bedeutung (Saunders et al., 2019). Neben einem transparenten Vorgehen ist insbesondere der Einbezug der Auftraggeberschaft wichtig, um einen stetigen Abgleich der Vorgehensweise mit den Zielsetzungen sicherzustellen (Bryman & Bell, 2011; Merkle et al., 2023). Im Sinne einer multi-methods Vorgehensweise wurden sowohl quantitative als auch qualitative Datensammlungsmethoden verwendet. Zunächst wurde eine Literaturrecherche durchgeführt mit dem Ziel, Key-Performance-Indikatoren herauszuarbeiten, die für eine vergleichende Prozessbetrachtung relevant sind, und für die nachfolgend ein Messkonzept erstellt wurde. Ausgehend vom Messkonzept erfolgten Datenerhebungen mittels Fragebogen und Interviews im Kantonsspital Baden. Diese erfolgten innerhalb 3 Wochen im Zeitraum vom 18. November bis 6. Dezember 2024. Vorgehen und Methodik zur Erhebung der Arbeitszeitersparnis, Patient:innen-Zufriedenheit, Mitarbeitenden-Zufriedenheit und Schadensfälle und Kulanzzahlungen wird folgend im Detail erläutert.

2.1 Festlegung von Key-Performance-Indikatoren (KPI) auf Basis einer Literaturrecherche

Das Management von Patienteneffekten in Spitälern und insbesondere in SDS-Prozessen hat trotz seiner betrieblichen Bedeutung bisher nur wenig wissenschaftliche Aufmerksamkeit erhalten. Obwohl SDS-Prozesse, Logistikprozesse oder Transport-/Transferprozesse direkt beschrieben oder untersucht wurden, bleibt das Gepäckmanagement häufig unerwähnt (Blay et al., 2017; Hendrich et al., 2008; Rosenberg et al., 2018; Sultan et al., 2022; Trovó et al., 2021). Bisherige Studien betonen die Rolle einer effizienten Logistik bei der Senkung der Gesundheitskosten und der Verbesserung der Patientenoutcomes (Feibert et al., 2019). Es hat sich gezeigt, dass der Einsatz von Technologien, wie z. B. Apps, die Prozesstransparenz verbessern und menschliche Fehler in der Logistik im Gesundheitswesen reduzieren kann (Feibert & Jacobsen, 2019).

In SDS-Prozessen, in denen es zu sehr häufigen Patientenwechseln kommt, steigt das Risiko, dass Gegenstände verlegt werden, erheblich. Forschungsergebnisse deuten darauf hin, dass SDS-Patienten häufig Probleme mit der Verwaltung ihrer persönlichen Gegenstände haben, was den Bedarf an innovativen Lösungen und effizienten Logistikprozessen unterstreicht (Haraden & Resar, 2004; Mixon, o. J.; Thoen et al., 2024).

Folgende mögliche KPIs wurden in der Literatur gefunden bzw. konnten von ähnlichen Untersuchungen abgeleitet werden:

- Kosten und Rechtliches (Garbutt et al., 2003; Marzano, 2022; Montini et al., 2008; Palter, 2022; Tu, 2014): Anzahl verlorener Gepäckstücke, Rückerstattungskosten, Anzahl Fälle für Rückerstattungskosten, weitere Kosten, Haftung, Anzahl Beschwerden zu verlorenem oder beschädigtem Gepäck

- Gepäckaufbewahrungstasche/-modul (Nicholas & Paoli, 2023; Sievers et al., 2016): Gewicht, Rückverfolgbarkeit, Sicherheit

- Dokumentation der Effekten (Nicholas & Paoli, 2023): Art der Dokumentation, Integration der Dokumentation ins Klinikinformationssystem

- Auswirkungen auf Patient:innen (Connelly, 2022; Garbutt et al., 2003; Wiggermann et al., 2019): Stress bei beschädigtem oder verlorenem Gepäck, Kosten bei beschädigtem oder verlorenem Gepäck, Wartezeit auf Gepäck nach Transport, Zufriedenheit mit Gepäckhandhabung

- (Gepäck)-Transport (Blay et al., 2017; Hendrich et al., 2008; van der Ham et al., 2019): Transportzeiten, Transportdistanzen, Anzahl an Transporten, Transportvolumen, Gehzeiten, Dokumentation von Transporten

- Gepäckaufbewahrung (Avinash & Joseph, 2024; Douglas & Douglas, 2005): Lagerkapazitäten, Platz für Patienteneffekten, Zufriedenheit mit Platz für Patienteneffekten

- Auswirkungen auf Pflege-/Gesundheitspersonal (Avinash & Joseph, 2024; Blay et al., 2017; Hendrich et al., 2008): Zeit für Gepäcksuche, Zeit für Packen und Entpacken von Patienteneffekten, Zufriedenheit mit Gepäckhandhabung

- Nachhaltigkeit (Mostepaniuk et al., 2023): Nachhaltigkeit von wiederverwendbaren Aufbewahrungslösungen

Anhand der in der Literatur gefundenen und abgeleiteten möglichen KPIs wurde partizipativ mit allen Projektbeteiligten und den gegebenen Prozessen vor Ort im KSB ein Messkonzept für die vergleichende Datenerhebung aufgestellt. Dabei wurde eine Gesamtprozessbetrachtung mit einer Unterscheidung nach patientennahen (z.B.

Kommunikation/Dokumentation) und patientenfernen (Aufbereitungs-/Reinigungsprozesse, Logistik) Prozessbestandteilen erarbeitet.

2.2. Datenerhebung und Datenanalyse

2.2.1 Häufigkeiten

Die Gesamtanzahl an Patient:innen im SDS-Prozess im Datensammlungszeitraum wurde klinikintern dokumentiert. Sowohl die Effektenverzeichnisse auf Papier als auch die Datendokumentation der ZippScan-App wurde bezüglich «Sondergepäck» pro Patient:in untersucht und diese abgegrenzt. Als Sondergepäck galten alle Gepäckstücke, die nicht in der Kunststoffbox oder ZippBag transportiert wurden und somit über einen separaten Transportgang über die Patientenlogistik vom SDS-Stützpunkt auf die Bettenstation transportiert wurden. Dazu zählten z.B. Gehstöcke, Rollatoren, Rollstühle, übergrosse Gepäckstücke, Extrataschen.

Die Pflegefachpersonen des SDS-Stützpunktes wurden über die Stationsleitung instruiert, im Datensammlungszeitraum die Anzahl an Gepäckstücken sehr genau auf den Effektenverzeichnissen auf Papier und in der ZippScan-App zu erfassen, damit die Auswertung gut nachvollziehbar durchgeführt werden konnte.

Die Analyse der Erhebung in den beiden Prozessen erfolgte quantitativ deskriptiv anhand von absoluten und prozentualen Häufigkeiten der Anzahl Gepäckstück und Sondergepäckstücke.

2.2.2 Fragebogen

Die Nutzendenzufriedenheit in den patientennahen Prozessen wurde mittels Fragebogen bei allen SDS-Patient:innen und den Pflegepersonen des SDS-Stützpunktes sowie der SDS-Bettenstationen erhoben.

Befragung der Patient:innen:

Der Patient:innenfragebogen enthielt Fragen zu: Methode der «Gepäckverpackung» (ZippBag oder Kunststoffbox); Einfachheit des Verstauens des Gepäcks; Einfachheit der Gepäckdokumentation (per Effektenverzeichnis auf Papier resp. per ZippScan-App); Einfachheit der Gepäckrückgabe im Zimmer nach der Operation; Wartezeit für die Gepäckrückgabe; Gefühl der Sicherheit des Gepäckverstauens; Zufriedenheit mit der Gepäckhandhabung insgesamt; sowie Alter und Geschlecht. Der erste Teil des

Fragebogens wurde mittels Likert-Skalen von «sehr einfach» bis «sehr kompliziert», «sehr sicher» bis «sehr unsicher» und «sehr zufrieden» bis «sehr unzufrieden» beantwortet. Ergänzend wurden zwei offene Fragen gestellt zu Dingen, die besonders gut oder besonders schlecht im Zusammenhang mit der Gepäckhandhabung empfunden wurden.

Die Fragebogen wurden von den Mitarbeitenden der Hotellerie auf die Nachttische der Patient:innen gelegt mit einem kurzen Flyer/Informationsblatt zur Umfrage. Die Hotellerie-Mitarbeitenden informierten die Patient:innen zusätzlich mündlich über die laufende Datenerhebung. Die Fragebogen konnten entweder von Hand auf Papier ausgefüllt werden oder über einen QR-Code online via dem webbasierten, elektronischen REDCap Datenerfassungssystem, das durch die ZHAW verwaltet wird (Harris et al., 2009, 2019). Auf Papier ausgefüllte Fragebogen wurden durch die Hotellerie-Mitarbeitenden oder Pflegepersonen entgegengenommen und in Aufbewahrungsboxen auf jeder Bettenstation gesammelt und danach ausgewertet. Die Stationsleitungen der SDS-Bettenstationen sowie die Leitung der Hotellerie wurden mündlich und schriftlich über die Datensammlung durch das ZHAW-Projektteam instruiert. Die Stationsleitungen und die Leitung Hotellerie leiteten die Instruktionsinformationen mündlich und schriftlich via Beekeeper an ihre Pflegeteams weiter. Zudem wurden zweimalig Reminder verschickt.

Befragung der Pflegefachpersonen:

Der Fragebogen für die Pflegefachpersonen enthielt Fragen nach der Zustimmung zu folgenden Aussagen: Einfachheit und Geschwindigkeit der Dokumentation des Patientengepäcks; Bequemlichkeit und Geschwindigkeit der Gepäckhandhabung; Häufigkeit der Gepäcksuche; Zufriedenheit mit dem Zipp&Scan-SDS-Prozess insgesamt und Angaben zu Arbeitsort (SDS-Stützpunkt oder Bettenstation) sowie Alter und Geschlecht, dabei wurden dieselben Likert-Skalen wie in der Patient:innenbefragung verwendet. Zudem konnten die Pflegefachpersonen ebenfalls offene Fragen zu besonders guten und schlechten Aspekten der Gepäckhandhabung im Zipp&Scan-Prozess angeben.

Der Fragebogen wurde durch die Pflegepersonen des SDS-Stützpunktes sowie der Zipp&Scan-Pilotbettenstationen beantwortet. Zugang zum Online-Fragebogen erhielten die Teilnehmenden über einen Link zum webbasierten, elektronischen

REDCap Datenerfassungssystem, das durch die ZHAW verwaltet wird (Harris et al., 2009, 2019). Die Einladung und Information zum Fragebogen erhielten die Pflegefachpersonen über die Stationsleitungen mündlich und schriftlich via Beekeeper. Die Stationsleitungen wurden mündlich und schriftlich durch das ZHAW-Projektteam instruiert. Im Datensammlungszeitraum wurde zweimalig ein Reminder zur Teilnahme verschickt.

Die Analyse der beiden Fragebogen erfolgte deskriptiv mit absoluten und prozentualen Häufigkeiten sowie Mittelwert und Standardabweichung resp. Median und Interquartilsbereich und Minimal- und Maximalwerten. Für die Analysen wurde die Statistiksoftware IBM SPSS Version 29 (IBM Corp., 2023) verwendet. Um die Anonymität der Pflegefachpersonen zu bewahren, wurde darauf verzichtet, Unterschiede in den Antworten zwischen den Pflegepersonen der SDS-Bettenstationen und des SDS-Stützpunktes zu analysieren. Die Analyse des Patientenfragebogens erfolgte getrennt nach den beiden Prozessen Zipp&Scan und Standardprozess.

2.2.3 Interviews

Die patientenfernen Prozesse wurden im Rahmen von insgesamt vier Einzelinterviews anhand eines halbstrukturierten Interviewleitfadens mit den durch das KSB benannten Fachexpert:innen der Abteilungen Patientenlogistik, Zentrallager, Bettenzentrale und Wäscherei durchgeführt. Die Interviewdauer betrug jeweils ungefähr 60 Minuten.

Zu beachten ist, dass die Abteilungen Zentrallager, Bettenzentrale und Wäscherei aktiv die patientenfernen Teilprozessschritte Zipp&Scan verantworten. Die Abteilung Patientenlogistik hingegen ist verantwortlich für den Standardgepäcktransport ohne Zipp&Scan. Ziel der Interviews war, den Aufwand der jeweiligen Abteilungen zu quantifizieren und in einer Gesamtschau vergleichen zu können. Im ersten Teil des Interviews wurden quantitative Angaben entlang der Teilprozessschritte der Abteilung abgefragt. Die erhobenen Zeitangaben basierten auf Schätzungen der Fachexpert:innen, die durch den Vergleich von Einzelangaben und aufsummierten Zeitangaben im Rahmen der Interviewmöglichkeiten in sich plausibilisiert wurden.

Im zweiten Teil der Interviews wurde eine qualitative Einschätzung der Fachexpertinnen aufgenommen, wobei die Zufriedenheit, Hürden und Risiken, Chancen sowie Empfehlungen für die Prozesseinführung im Fokus standen.

Die Analyse der ersten Teile der Interviews erfolgte quantitativ durch Aufzählung und Summenbildung der geschätzten Anzahl Minuten pro Fachabteilung. Die Analyse des zweiten Teils der Interviews folgte der Methode des Knowledge Mappings, die einen zusammenfassenden, inhaltsanalytischen Auswertungsprozess vorsieht und eine schrittweise Verdichtung und Ordnung der Diskussionsinhalte beinhaltet (Pelz et al., 2004). Nach den Interviews wurde eine Qualitätssicherung der Knowledge Maps anhand der Audioaufnahmen durchgeführt und die Knowledge Maps, wo nötig, vervollständigt (gemäss Rettke et al., 2015). Anschliessend wurden die Aussagen zur Zufriedenheit, den Hürden und Risiken, Chancen sowie den Empfehlungen für die Prozesseinführung zusammengetragen. Weiterhin erfolgte eine Reduktion auf die wesentlichen Kernaussagen und dessen grafische Darstellung in einem zusammenfassenden Knowledge Map.

2.2.4 Schadensfälle und Kulanzzahlungen

Die Rechtsabteilung des KSB erhob die Anzahl an Schadensfällen und damit verbundene Kulanzzahlungen, die auf verlorenes oder beschädigtes Gepäck und persönliche Gegenstände von Patient:innen zurückzuführen war. Der Beobachtungszeitraum war hierbei von Mai – Dezember 2024, seit der Einführung des SDS-Prozesses im KSB. Vorabklärungen hatten ergeben, dass Schadensfälle insgesamt selten sind, so dass ein möglichst langer Beobachtungs-Zeitraum sinnvoll erschien. Klinikintern wurde anhand der Patientenidentifikationsnummer überprüft, ob es sich bei allfälligen Schadensfällen um Patient:innen im SDS-Prozess handelte und ob diese im Zipp&Scan-Prozess behandelt wurden. Die erhobenen Daten wurden anonym an das ZHAW-Projektteam übermittelt. Die Analyse erfolgte quantitativ deskriptiv mit absoluten Häufigkeiten der Anzahl Schadensfällen und in Absolutzahlen für die Kulanzzahlungen. Die Analyse und Zuordnung erfolgten nur für die Patienten im SDS-Prozess. Dies begründet sich dadurch, dass nur aufgrund der Verwendung der Zipp&Scan-App Patienten eindeutig und automatisiert ein Transportprozess zugeordnet werden konnte. Die papierbasierte Zuordnung verursacht einen hohen Aufwand und muss von Schadensfällen durch Verluste bei Transportprozessen von Notfallpatienten, sowie anderen Inzidenzen während des Spitalaufenthalts bereinigt werden.

3. Ergebnisse

3.1. Grunddaten

Im Studienzeitraum wurden insgesamt 169 Patient:innen im SDS-Prozess behandelt. Davon traten 75 Patient:innen (44 %) über den Pilotprozess mit Zipp&Scan ein, während 94 Patient:innen (56 %) im Standardprozess mit fester Kunststoffbox waren. Insgesamt wurden 97 ZippBags ausgegeben, wobei die drei Viertel der Patient:innen einen ZippBag benötigten, um ihr Gepäck zu verstauen. Ca. ein Viertel der Patient:innen benötigten zwei ZippBags und ein:e Patient:in benötigte drei Zipp-Bags. Bei den SDS-Patient:innen im Standardprozess hatten ca. 70 % eine Kunststoffbox. Die restlichen Patient:innen hatten nur ein mit einer Patientenetikette beschriftetes Gepäckstück, das so von der Patientenlogistik auf die Bettenstation transportiert wurde. Im Pilotprozess hatten 16 % der Patient:innen ein Sondergepäckstück, das separat über die Patientenlogistik transportiert werden musste. Bei den Patient:innen im Standardprozess waren es ca. ein Drittel der Patient:innen mit ein bis zwei Sondergepäckstücken.

3.2. Patient:innen - Zufriedenheit

Insgesamt nahmen an der Patient:innen-Befragung 45 Teilnehmende teil. Davon haben 26/75 Personen (35%) teilgenommen, die im neuen Zipp&Scan-Pilotprozess waren und 19/94 (20%) Personen , die im Standardprozess mit fester Kunststoffbox waren. Bei den Teilnehmenden, die im Pilotprozess waren, war die Geschlechterverteilung ausgeglichen, im Standardprozess nahmen deutlich mehr Männer (n = 15, 79 %) als Frauen teil (n = 4, 21 %). Die Altersverteilung zwischen den beiden Prozess-Gruppen war annähernd gleich mit Mittelwert von 59 ± 15, resp. 58 ± 16 Jahren.

Die befragten Patient:innen beurteilten in beiden Prozessen die Einfachheit des Gepäckverstauens, der Gepäckrückgabe im Zimmer nach der Operation, sowie das Gefühl, dass das Gepäck während der Operation sicher verstaut ist ähnlich, nämlich mit hohen Zustimmungswerten. Insgesamt waren die befragten SDS-Patient:innen im Zipp&Scan-Prozess zufriedener mit der Gepäckhandhabung als die Patient:innen im Standardprozess mit der festen Kunststoffbox. Es gab mehr Patient:innen im Pilotprozess, die sehr zufrieden waren und keine Patient:innen, die unzufrieden waren im Gegensatz zu den Befragten im Standardprozess. Einzig bei der Wartezeit auf das Gepäck nach der Operation zeigten sich deutliche Unterschiede zwischen den Befragten, siehe Abbildung 1.

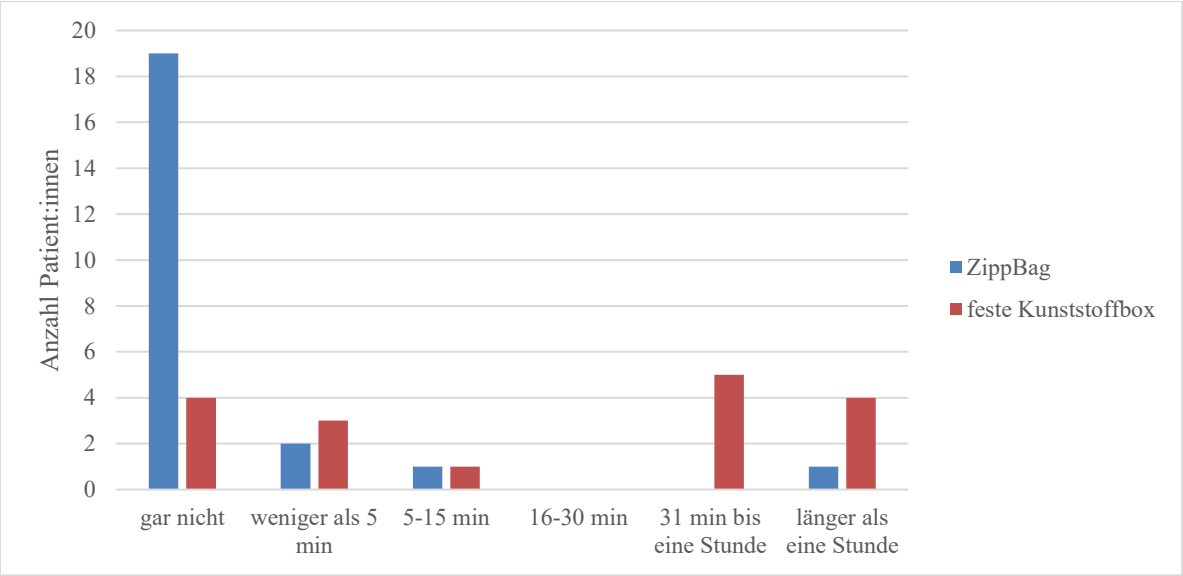

Abbildung 1: Patient:innenbefragung: Wartezeit auf Gepäck nach der Operation

Die Antworten der offenen Fragen verdeutlichen die hohe Zufriedenheit insbesondere der Patient:innen mit ZippBags. Negativ gesehen wurde, dass die ZippBags etwas unhandlich und schwer zum Heben für das Personal waren. Bei den Patient:innen mit Kunststoffbox gefiel die Grösse der Box. Allerdings wurde die Kunststoffbox als eher unhygienisch empfunden und es musste bei diesen Patient:innen nach verlegten Gepäckstücken gesucht werden nach der Operation.

3.3. Arbeitszeitersparnis und Zufriedenheit Mitarbeitende patientennahe Prozesse

An der Mitarbeitenden-Befragung der patientennahen Prozesse nahmen insgesamt drei (von drei möglichen) Pflegefachpersonen des SDS-Stützpunktes und fünf (von 49 möglichen) Pflegefachpersonen von der Bettenstation, die im Pilotprozess beteiligt war, teil. Alle befragten Pflegefachpersonen waren weiblich und im Durchschnitt 26 Jahre alt.

Es gab mehr Zustimmungswerte für den Zipp&Scan-Prozess als für den Standardprozess bei Frage nach der Dokumentation des Gepäcks, sowohl für die Einfachheit als auch Geschwindigkeit der Dokumentation. Bei der Bequemlichkeit und Schnelligkeit der Handhabung des Gepäcks gab es gleich viel Zustimmungs- wie Ablehnungswerte zu den Aussagen, hier schienen sich die befragten Pflegefachpersonen nicht einig zu sein. Einig waren sie sich Teilnehmenden jedoch darüber, dass im Zipp&Scan-Prozess deutlich weniger häufig nach Gepäckstücken gesucht werden muss als im Standardprozess. Zudem zeigt sich eine Mehrheit der

Befragten insgesamt zufriedener mit dem Zipp&Scan-Prozess als mit dem Standard-Prozess.

In den Antworten zu den offenen Fragen zeigte sich, dass viele Pflegefachpersonen die Idee des Zipp&Scan-Prozesses grundsätzlich gut finden. Dennoch zeigten sich einige Dinge, die aus der Sicht der Befragten etwas nachteilig oder verbesserungswürdig sind. Dazu gehören einige technische Schwierigkeiten mit der ZippScan-App bei z.B. älteren Personen, die die Unterschrift mit dem Finger auf dem Display nicht tätigen konnten. Zudem scheint die ZippBag für zerbrechliche Gegenstände nicht genügend Schutz zu bieten. Auch bei den Pflegefachpersonen wurde das zu handhabende Gewicht durch die ZippBag bemängelt.

3.4. Arbeitszeitersparnis und Zufriedenheit Mitarbeitende patientenferne Prozesse

Die Fachexpert:innen der Bettenzentrale Wäscherei, des Zentrallagers und der Patientenlogistik schätzten die Dauer der Personalbindungszeit für ihre jeweilige Abteilung gemäss Tabelle 1 ein.

Tabelle 1: Personalbindungszeit patientenferne Prozesse

Abteilung	***Dauer Personalbindungszeit pro ZippBag/Kunststoffbox summiert [Minuten]***
Bettenzentrale	1.5
Wäscherei	3.5
Zentrallager	1.3
Patientenlogistik	5.3

Insgesamt über alle Prozessschritte in den patientennahen und patientenfernen Prozessen ergab sich im Standardprozess aufsummiert ein Zeitaufwand von 16.5 Minuten für den Gepäckhandlingprozess. Im Zipp&Scan-Prozess ergab sich aufsummiert ein Gesamtzeitaufwand von 16 Minuten. Somit lag die Zeitdifferenz im untersuchten Pilotprozess bei 30 Sekunden, bzw. bei 3.1%. Wesentlicher Unterschied war, dass der Aufwand für den separaten Transport des Gepäcks entfiel, da die ZippBag am Patientenbett hängend transportiert wurde. Dafür musste jedoch zusätzliche Personalbindungszeit für die Aufbereitung und Bereitstellungsprozesse in

der Bettenzentrale, dem Zentrallager und der Wäscherei für die ZippBag nach jeder Nutzung berücksichtigt werden.

Bezüglich Zufriedenheit wurden zwei positive Einschätzungen wiedergegeben: für die Patientenlogistik, die den Standard-Gepäcktransport von der SDS-Einheit auf die Stationen erbringt, bedeutete dies eine «vergleichsweise aufwendige» Abweichung von den routine-mässigen Logistikaufgaben. Die Bereinigung des Leistungsportfolios wurde daher befürwortet. Als weitere positive Einschätzung nannte die Bettenzentrale die für sie unproblematische erfolgte Einführung des Prozessschritts der Hakendesinfektion. Bei den Hürden und Risken wurde neben dem Risiko der Beschädigung der Waschtrommel im Reinigungsprozess für den Fall, dass der Transporthaken nicht vor der Reinigung vom ZippBag getrennt wurde, auch der Mangel an ausreichenden Dienst-Handys für die Mitarbeitenden als Voraussetzung für die Nutzung der ZippScan-App in der Pilotphase benannt. Zu den Chancen des Zipp&Scan-Prozess wurde die Reduzierung von Wartezeiten und eine Verringerung der Abhängigkeit von Liftkapazitäten durch den Wegfall separater Gepäcktransport als Chance benannt, sowie die Möglichkeit der durchgängigen Erfassung der Prozessschritte durch die ZippScan-App. Die Interviewteilnehmenden nannten folgende Empfehlungen für die Prozesseinführung: Es wurde auf die Sicherstellung geeigneter Stellflächen für die Transportmodule hingewiesen, die Durchführung einer Testphase angeregt und auf die Thematik Kommunikation und Schulung aller Beteiligten hingewiesen. Die Definitionen der Prozessabläufe, Schnittstellen, wie auch Hygiene- und Materialvorgaben im Kantonsspital Baden wurden als übertragbar auf andere Spitäler eingeschätzt. Im Hinblick auf die Zwischenlagerung der ZippBags im OP gab es Optimierungsideen, sowie – für den Fall eines Neubauprojekt – die Empfehlung, Raumgrössen und Lage möglichst nah zu planen.

3.5. Schadensfälle und Kulanzzahlungen

Bezüglich Schadensfällen wurden für den Betrachtungszeitraum keine Verluste von Eigentum von Patient:innen im Zipp&Scan-Prozess verzeichnet und somit auch keine Kulanzzahlungen notwendig. Es konnte jedoch keine vergleichende Aussage dazu getroffen werden, dass bei SDS-Patienten im gleichen Zeitraum aufgrund des Gepäcktransports mit dem Standardprozess Verluste, die zu Kulanzzahlungen führten, verzeichnet wurden.

4. Diskussion der Ergebnisse, Zusammenfassung und Ausblick

Die Ergebnisse der Studie zeigen einerseits eine Steigerung der Prozesseffizienz um ca. 3,1% (30 Sekunden) und höhere Zufriedenheit bei den Patient:innen, insbesondere hinsichtlich der Verkürzung von Wartezeiten bei der Rückgabe von Gepäck. Andererseits zeigt sich bei der Zufriedenheit der Pflegenden kein eindeutiges Bild. Dabei ist anzumerken, dass der Rücklauf zur Befragung mit drei (von drei möglichen) Pflegefachpersonen des SDS-Stützpunktes und fünf (von 49 möglichen) Pflegefachpersonen von der Bettenstation für letzteren Bereich relativ niedrig war und die Repräsentativität daher eingeschränkt. Die Studie wurde in der Pilotphase von Zipp&Scan durchgeführt, in der das Effektenhandling sowohl im bisherigen als auch mit dem neuen Prozessablauf parallel am Kantonsspital erfolgte. Dies hatte den Vorteil, dass Daten unmittelbar über denselben Zeitraum erhoben werden konnten. Allerdings fehlten noch für den neuen Ablauf erforderliche mobile Geräte, was die Einschätzungen zur Effizienz und Zufriedenheit negativ beeinflusst haben könnte. Diese Einschränkung gilt auch für Effizienzgewinne durch eine potenziell verbesserte Auslastung bei den Logistik- und Aufbereitungsprozessen der Zippbags nach einer Gesamtprozessumstellung. Eine Wiederholung der Datenerhebung nach einem gewissen Zeitraum nach der Gesamtumstellung könnte hier voraussichtlich eine verbesserte Zufriedenheit und eine höhere Arbeitszeitersparnis ergeben. Für eine vertiefte Betrachtung und Einordnung der Zeitersparnis wären stichprobenartige Beobachtungen vor Ort und die Messung und Dokumentation in Ergänzung zur Auswertung der Zeitdaten der App sinnvoll. Insgesamt konnte das Projekt belegen, dass der Pilotprozess Zipp&Scan am Kantonsspital Baden sehr gut entwickelt und dokumentiert ist und einen wichtigen Beitrag als Referenz für die Einführung eines App-gestützten, nutzendenfreundlichen und effizienzorientieren Transportsystems für weitere Spitäler bildet.

5. Literaturverzeichnis

Avinash, B., & Joseph, G. (2024). Reimagining healthcare supply chains: A systematic review on digital transformation with specific focus on efficiency, transparency and responsiveness. Journal of Health Organization and Management. https://doi.org/10.1108/JHOM-03-2024-0076

Blay, N., Roche, M. A., Duffield, C., & Gallagher, R. (2017). Intrahospital transfers and the impact on nursing workload. Journal of Clinical Nursing, 26(23–24), 4822–4829. https://doi.org/10.1111/jocn.13838

Bryman, A., & Bell, E. (2011). Business Research Methods (3. Aufl.). OUP Oxford.

Connelly, N. (2022, April 20). Protecting Patient Possessions. ASHRM. https://forum.ashrm.org/2022/04/20/protecting-patient-possessions/

Diez, K., Merkle, T., Kramer, I., Zigan, N., Loderer, C., & Struffi, D. (2025, Januar 30). Zipp & Scan-Prozess am Kantonsspital Baden zur Optimierung des Effektenhandlings von Same-Day-Surgery-Patient:innen. Spotlight FMplus, Zürich.

Douglas, C. H., & Douglas, M. R. (2005). Patient-centred improvements in health-care built environments: Perspectives and design indicators. Health Expectations, 8(3), 264–276. https://doi.org/10.1111/j.1369-7625.2005.00336.x

Feibert, D. C., Andersen, B., & Jacobsen, P. (2019). Benchmarking healthcare logistics processes – a comparative case study of Danish and US hospitals. Total Quality Management & Business Excellence, 30(1–2), 108–134. https://doi.org/10.1080/14783363.2017.1299570

Feibert, D. C., & Jacobsen, P. (2019). Factors impacting technology adoption in hospital bed logistics. The International Journal of Logistics Management, 30(1), 195–230. https://doi.org/10.1108/IJLM-02-2017-0043

Garbutt, J., Bose, D., McCawley, B. A., Burroughs, T., & Medoff, G. (2003). Soliciting Patient Complaints to Improve Performance. The Joint Commission Journal on Quality and Safety, 29(3), 103–112. https://doi.org/10.1016/S1549-3741(03)29013-4

Haraden, C., & Resar, R. (2004). Patient flow in hospitals: Understanding and controlling it better. Frontiers of Health Services Management, 20(4), 3–15.

Harris, P. A., Taylor, R., Minor, B. L., Elliott, V., Fernandez, M., O'Neal, L., McLeod, L., Delacqua, G., Delacqua, F., Kirby, J., & Duda, S. N. (2019). The REDCap consortium: Building an international community of software platform partners. Journal of Biomedical Informatics, 95, 103208. https://doi.org/10.1016/j.jbi.2019.103208

Harris, P. A., Taylor, R., Thielke, R., Payne, J., Gonzalez, N., & Conde, J. G. (2009). Research electronic data capture (REDCap)—A metadata-driven methodology and workflow process for providing translational research informatics support. Journal of Biomedical Informatics, 42(2), 377–381. https://doi.org/10.1016/j.jbi.2008.08.010

Hendrich, A., Chow, M. P., Skierczynski, B. A., & Lu, Z. (2008). A 36-Hospital Time and Motion Study: How Do Medical-Surgical Nurses Spend Their Time? The Permanente Journal, 12(3), 25–34.

IBM Corp. (2023). IBM SPSS Statistics for Windows, Version 29.0 [Software]. IBM Corp.

Marzano, S. (2022). Improving Inpatient Belonging Process to Eliminate Reimbursement Costs and Improve Patient Satisfaction [Masteressay, University of Pittsburgh]. https://d-scholarship.pitt.edu/42613/

Merkle, T., Knaus, D., & Siegrist, C. (2023). Closing the Service Innovation Gap: The Case of a Fast Food Chain in Central Europe. In Case based research in tourism, travel, hospitality and events: Rethinking theory and practice. Springer.

Mixon, C. (o. J.). Managing Patient Belongings: A Shared Responsibility - The Beryl Institute. Abgerufen 20. März 2025, von https://theberylinstitute.org/product/managing-patient-belongings-a-shared-responsibility/

Montini, T., Noble, A. A., & Stelfox, H. T. (2008). Content analysis of patient complaints. International Journal for Quality in Health Care, 20(6), 412–420. https://doi.org/10.1093/intqhc/mzn041

Mostepaniuk, A., Akalin, T., & Parish, M. R. (2023). Practices Pursuing the Sustainability of A Healthcare Organization: A Systematic Review. Sustainability, 15(3), 2353. https://doi.org/10.3390/su15032353

Nicholas, A., & Paoli, D. (2023, Dezember 5). Navigating the Complex Landscape of Missing Patient Belongings: Can a simple form save you thousands of dollars? Interlace Health. https://interlacehealth.com/navigating-the-complex-landscape-of-missing-patient-belongings-can-a-simple-form-save-you-thousands-of-dollars/

Palter, J. (2022, November 16). A Guide to Better Patient Belongings Management in Healthcare Centers. https://www.realtimenetworks.com/blog/patient-belongings-management-in-healthcare-centers

Pelz, C., Schmitt, A., & Meis, M. (2004). Knowledge Mapping als Methode zur Auswertung und Ergebnispräsentation von Fokusgruppen in der Markt- und Evaluationsforschung. Forum Qualitative Sozialforschung, 5(2). http://dx.doi.org/10.17169/fqs-5.2.601

Rettke, H., Frei, I. A., Horlacher, K., Kleinknecht-Dolf, M., Spichiger, E., & Spirig, R. (2015). Pflege im Vorfeld von SwissDRG – Erfahrungen von Pflegenden mit interprofessioneller Zusammenarbeit, Führungsverhalten, Arbeitslast und Arbeitszufriedenheit. Pflege, 28(3), 133–144. https://doi.org/10.1024/1012-5302/a000421

Rosenberg, A., Britton, M. C., Feder, S., Minges, K., Hodshon, B., Chaudhry, S. I., Jenq, G. Y., & Emerson, B. L. (2018). A taxonomy and cultural analysis of intra-hospital patient transfers. Research in nursing & health, 10.1002/nur.21875. https://doi.org/10.1002/nur.21875

Saunders, M., Lewis, P., & Thornhill, A. (2019). Research Methods For Business Students.

Sievers, S., Heise, G., Kang, M., & Totty, M. (2016). Lost and Found: Use of GPS Technology to Improve Storage of Patient Belongings in Hospital Setting. Chancellor's Honors Program Projects. https://trace.tennessee.edu/utk_chanhonoproj/1956

Sultan, A., Hussain, M. I., Sellahewa, C., Bird, J., & Glover, G. (2022). EGS P05 Surgical Same Day Emergency Care at a District General Hospital—Our Experience. British Journal of Surgery, 109(Supplement_9), znac404.070. https://doi.org/10.1093/bjs/znac404.070

Taylor, A. (2019, Oktober 14). 3 Ideas to Improve Patient Satisfaction. Outpatient Surgery Magazine. https://www.aorn.org/outpatient-surgery/article/2019-October-3-ideas-to-improve-patient-satisfaction

Thoen, C. W., Sæle, M., Strandberg, R. B., Eide, P. H., & Kinn, L. G. (2024). Patients' experiences of day surgery and recovery: A meta-ethnography. Nursing Open, 11(1), e2055. https://doi.org/10.1002/nop2.2055

Trovó, S. A., Cucolo, D. F., & Perroca, M. G. (2021). Transfer of patients in hospital units: Impacts on nursing workload. Revista Da Escola de Enfermagem Da USP, 55, e0327. https://doi.org/10.1590/s1980-220x2020024903727

Tu, A. (2014). Tracking Patient Belongings to Decrease Cost. Master's Projects and Capstones. https://repository.usfca.edu/capstone/72

van der Ham, A., Boersma, H., van Raak, A., Ruwaard, D., & van Merode, F. (2019). Identifying logistical parameters in hospitals: Does literature reflect integration in hospitals? A scoping study. Health Services Management Research, 32(3), 158–165. https://doi.org/10.1177/0951484818813488

Wiggermann, N., Rempel, K., Zerhusen, R. M., Pelo, T., & Mann, N. (2019). Human-Centered Design Process for a Hospital Bed: Promoting Patient Safety and Ease of Use. Ergonomics in Design: The Quarterly of Human Factors Applications, 27(2), 4–12. https://doi.org/10.1177/1064804618805570

Williams, A., Ching, M., & Loader, J. (2003). ASSESSING PATIENT SATISFACTION WITH DAY SURGERY AT A METROPOLITAN PUBLIC HOSPITAL. Australian Journal of Advanced Nursing, 21(1). https://doi.org/10.37464/2003.211.2021

Zippsafe. (o. J.). Zipp & Scan—Die neue Art Patienteneigentum zu transportier... Zipp & Scan - Die neue Art Patienteneigentum zu transportieren & managen. Abgerufen 11. Februar 2025, von https://www.zippsafe.com/eu_de/produkte/wertsachentransport

Leveraging AI-Driven Optimization and Dynamic Service Allocation in Ethiopia: A Platform-Based Model for Smart and Sustainable Facility Management

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Abstract:

The digital transformation of facility management (FM) is essential for creating smart, interconnected, and sustainable building ecosystems. While this transformation is advanced in sectors like logistics and on-demand delivery, Ethiopia's FM sector remains in its infancy, characterized by fragmented, traditional practices. However, rapid urbanization, significant infrastructure development, and a growing young, tech-adaptable population create a unique opportunity for Ethiopia to leapfrog legacy systems and adopt innovative, platform-based FM models directly. This paper assesses the applicability of best practices from digitally transformed industries such as AI-driven allocation, dynamic pricing, and user ratings to the Ethiopian context. It proposes a conceptual platform-based FM business model tailored to the country's specific needs and constraints. The model leverages scalable technologies like AI, IoT, and blockchain to create an on-demand digital marketplace that connects clients with certified service providers. By applying algorithmic matching and automated workflows, the study explores how Ethiopia can harness the adaptability of platform economies to overcome current inefficiencies, even while building its FM capacity. The paper critically examines adoption barriers, including digital infrastructure limitations, regulatory frameworks, and workforce skill gaps, proposing context-specific mitigation strategies derived from global lessons. The findings suggest that a strategically adapted, digitally integrated FM marketplace could provide Ethiopia with a cost-effective, transparent, and sustainable path to managing its built environment, aligning

with national goals for smart urban development and resilience. This study offers a roadmap for implementing a future-proof FM approach in emerging economies, turning developmental challenges into opportunities for innovation.

Keywords:

AI-Driven Facility Management, Platform-Based Service Model, Sustainable FM, Ethiopia, Digital Leapfrogging, Emerging Economies

6. Introduction

Facility management (FM) is at a critical juncture, where digital transformation is essential for efficient, sustainable, and resilient building maintenance & operations (Eric Whitley, 2023; Sampaio et al., 2022). However, FM in developing regions, particularly Ethiopia, remains largely manual, reactive, and fragmented (Desbalo et al., 2024). This results in high operational costs, delayed interventions, poor accountability, and hindered sustainability progress. This disconnect persists despite the transformative success of platform models leveraging real-time data, algorithmic matching, and user feedback in sectors like ride-hailing, logistics, and e-commerce.

Ethiopia, experiencing rapid urbanization (Desbalo et al., 2024) and infrastructure development, presents a significant opportunity. With a growing tech-savvy population, increasing mobile/internet penetration, and government digital initiatives (e.g., Digital Ethiopia 2025) , the country is well-positioned to adopt innovative FM solutions. We posit that the core principles of successful platforms on-demand access, dynamic resource allocation, transparency, and data-driven optimization are directly transferable and transformative for FM, potentially bypassing legacy constraints.

This paper, therefore, aims to propose and analyze a conceptual AI-driven platform-based model for smart and sustainable FM in Ethiopia. Its specific objectives are to:

1. Systematically review best practices from digitally transformed industries and nascent digital FM initiatives.
2. Identify key technological and operational success factors transferable to FM.

Table 1: Persistent Challenges of Traditional FM

Category of Challenges	*Description*	*References*
Technological	Lack of Digital Integration; Limited Adoption of Advanced Technologies	(Abdelalim et al., 2025; Azzran et al., 2019; Clark, 2019; Gunasekara & Sridarran, 2021; Shuhaimi et al., 2024)
Operational	Reactive Maintenance Approaches; fragmented data integration	(Abdelalim et al., 2025; Durmus et al., 2025; Mohammed et al., 2025; Trigka, 2025)
Human Factors	Skill and Knowledge Gaps; Resistance to Change	(Durmus et al., 2025; Elmualim et al., 2010; Sarpin et al., 2018; Støre-Valen & Buser, 2019)
Strategic and Organizational	Lack of Strategic Leadership; Stakeholder Involvement	(Sedhom et al., 2023; Twum-Bobie et al., 2025). (Elmualim & Gilder, 2014; Støre-Valen & Buser, 2019)

Traditional FM practices face numerous challenges that impede their efficiency and effectiveness. Addressing these challenges requires a concerted effort to adopt advanced technologies, enhance skills and knowledge, and foster strategic leadership and stakeholder involvement. By overcoming these barriers, FM can significantly improve operational efficiency, sustainability, and overall organizational performance.

FM professionals and organizations must adopt holistic frameworks that address the interaction between technological, operational, human, strategic, and organizational dimensions. Future research should focus on developing adaptive models, interdisciplinary interventions, and context-specific solutions to drive FM transformation and innovation (Barnes, 2013; Haleel & Dawood, 2023; Mazlan et al., 2025; Norliana & Jay, 2016; Wei et al., 2012)

2.1. Success Stories from the Platform/Gig Economy

The platform economy has demonstrably transformed service sectors through core technological and operational innovations, offering valuable paradigms for digital

transformation. Algorithmic matching and dynamic resource allocation, exemplified by ride-hailing platforms like Uber (Kumar, 2023), optimize real-time connections between decentralized supply (drivers) and demand (passengers), significantly enhancing service accessibility and efficiency while creating flexible income opportunities (Kumar, 2023). Similarly, peer-to-peer marketplace models, pioneered by Airbnb (Clauss et al., 2019), disrupt traditional industries (e.g., accommodation) by unlocking underutilized assets and empowering individuals as micro-entrepreneurs, generating substantial economic benefits for providers and local economies (Kumar, 2023; Wessel et al., 2018). In e-commerce, integrated logistics networks and data-driven optimization, central to Amazon's dominance (Brühl, 2023), leverage vast datasets and AI for predictive analytics, inventory management, and route efficiency, setting benchmarks for operational excellence and customer-centricity. Furthermore, platforms like Alibaba (Radonjic-Simic & Pfisterer, 2019) facilitate democratized market access, enabling SMEs to overcome geographical barriers and engage in global trade, thereby stimulating economic scaling and revenue growth. Beyond purely commercial models, platform cooperatives (Power et al., 2024) demonstrate alternative governance structures emphasizing democratic ownership and equitable value distribution, addressing social equity concerns within the gig economy through principles of solidarity and fair labor practices. Collectively, these platforms underscore the transformative potential of network effects, real-time data utilization, user rating systems, and workflow automation in driving economic growth (Kumar, 2023), fostering innovation (Brühl, 2023), and enhancing resource efficiency. However, their sustainability hinges on resolving persistent regulatory challenges, particularly concerning labor rights and market fairness , and aligning growth with broader sustainable development goals (Elnour et al., 2024).

2.2.Emerging Trends in Digital FM

Digital Facility Management (DFM) is undergoing a paradigm shift driven by the convergence of advanced technologies and fundamental operational re-engineering. Core to this transformation is the integration of Building Information Modeling (BIM) (Hakimi et al., 2024; Olimat et al., 2023), providing semantically rich digital representations of facilities that form a critical foundation for data-driven management throughout the asset lifecycle. This is augmented by pervasive Internet of Things (IoT) deployments (Hakimi et al., 2024; Olimat et al., 2023; Trigka, 2025), enabling

real-time data acquisition on asset performance, environmental conditions, and resource consumption (energy, water), facilitating granular monitoring and optimization.

In the context of Building Information Modeling (BIM), Digital Twin (DT) technology (Hakimi et al., 2024; Olimat et al., 2023) leverages IoT data to create dynamic virtual replicas. This BIM-enabled approach allows for advanced simulation, predictive analysis, and real-time performance benchmarking by utilizing the rich semantic data inherent in the BIM model. Artificial Intelligence (AI) and Machine Learning (ML) (Hakimi et al., 2024) are increasingly essential, utilizing the data streams from IoT and DT to enable predictive maintenance, real-time asset prognostics and health management (PHM), anomaly detection, and optimized resource allocation, moving beyond reactive models. Blockchain technology (Olimat et al., 2023) is emerging as a potential solution for enhancing data security, integrity, and enabling trusted automated transactions (e.g., via smart contracts) within complex FM ecosystems.

These technologies collectively enable critical operational paradigm shifts: the transition from static to real-time data flows (Atta, 2021), supporting dynamic decision-making; the move from linear, siloed processes to integrated, network-based workflows, improving cross-functional collaboration and efficiency; the evolution from static systems to adaptive systems (Atta, 2021) capable of responding dynamically to operational changes and occupant needs; and the shift from work-intensive to information-intensive scenarios, where data analytics drives actions. This transformation is particularly crucial in sensitive environments like healthcare facilities, where robust DFM is vital for operational resilience, as highlighted post-COVID-19 (Schmitter & Ashworth, 2023).

However, significant challenges persist, including complexities in data handling, integration, and interoperability (Hakimi et al., 2024; Olimat et al., 2023) across heterogeneous systems, and user acceptance barriers where factors like effort expectancy and performance expectancy significantly influence adoption. Key research priorities include advancing AI-based real-time PHM (Hakimi et al., 2024), developing virtual-based intelligent monitoring and deep learning-aided continuous improvement systems, and achieving enhanced semantically rich data

interoperability (Hakimi et al., 2024) across the entire facility lifecycle to fully realize the potential of cyber-physical integration in FM.

2.3.Theoretical Underpinnings

The development of the proposed framework was guided by a mix of several main theories. Each one played a role in shaping different aspects of the model's design and operation.

- **Platform Business Model Theory**: provided the main structure, helping create a multi-sided platform that allows value-creating interactions between clients (facility managers) and service providers (gig workers/vendors). This theory supported the basic platform setup.
- **Gig Economy Principles** were key in building the resource mobilization layer. These principles shaped how we recruit on-demand workers, match tasks dynamically, and include trust-building features like ratings and reviews to maintain quality in a flexible labor pool.
- **Service Operations Management theory:** offered design principles for the main service delivery workflows. It ensured that the platform's processes ranging from work order creation to completion and quality assurance are efficient, reliable, and responsive to customers.
- **Optimization Theory:** provided tools for our key algorithms. It supports the development of the matching and allocation engines, such as using linear programming for assignments or genetic algorithms for complex routing, to address the resource allocation challenges.
- **The Technology Organization-Environment (TOE) Framework:** helped us identify important factors for implementation. It guided our analysis of technological needs, organizational hurdles, and environmental conditions like regulatory and market factors necessary for the successful launch of the framework in the real world.

This well-structured theoretical foundation ensures the model is not only technically sound but also economically viable, operationally efficient, and easy to adopt.

1. Research Methodology

3.1. Research Approach

This paper employs a two-pronged methodological approach: (1) A Review of related literature to synthesize knowledge from digitally transformed industries and digital FM, and (2) Conceptual Model Development based on the review findings, tailored to the Ethiopian context using secondary data analysis.

3.2. Conceptual Model Development

The SLR findings are synthesized into a coherent platform architecture and operational workflow. Key design decisions (technology choices, workflow steps, governance mechanisms) are explicitly linked to the identified best practices and transferable principles. Ethiopian contextual factors (e.g., infrastructure constraints, workforce characteristics, regulatory landscape) derived from secondary sources (World Bank reports, Ethiopian government policy documents, industry analyses) are integrated to ensure model feasibility and relevance.

3.3. Contextual Analysis

Focused review of secondary data in Ethiopia

Urbanization rates, internet/mobile penetration statistics, power grid reliability, existing digital payment infrastructure (e.g., Hello Cash, M-Birr, M-PESA, Tele birr, CBE birr, mobile banking), government digital initiatives, informal sector dynamics, current FM market structure, and relevant regulatory frameworks (labor, data protection, contracting).

4. Proposed AI-Driven Platform Model for FM and Building Maintenance in Ethiopia

4.1. Vision & Value Proposition

To create a unified digital marketplace **("Ethio-FM&BM Platform")** connecting building owners/managers (Clients) with certified maintenance and FM service providers (Vendors) across Ethiopia. The platform-based FM framework was developed by incorporating lessons learned from other industries that have successfully utilized this model (Chen et al., 2022; Xu et al., 2019; Yang et al., 2024). Core value: On-demand access to qualified services, AI-optimized efficiency in allocation and execution, unprecedented transparency via blockchain, cost

reduction through competition and optimization, enhanced sustainability via reduced resource consumption, and data-driven insights for proactive management.

4.2. Platform Architecture Overview

The system architecture for the platform-based Facility Management is structured into four layers: Infrastructure, System, Application, and Interaction. Each layer is designed to handle specific functions and processes within the facility management system. A similar architecture has been successfully applied to on-demand service delivery across various industries (Chen et al., 2022; Xu et al., 2019; Yang et al., 2024).

- **Infrastructure Layer:** This layer provides the fundamental resources for the system. It includes backup servers and production servers, which can be cloud-based or on-premises. These servers manage the storage of data in backup and production databases. The layer also emphasizes security with encryption and SSL protocols for data protection (Figure 1).

- **System Layer:** The core system layer encompasses the company website and ERP/CRM systems, which are essential for managing enterprise-wide operations. An IoT platform is also included for integrating smart sensors, enabling real-time data collection from various facility components. This layer is crucial for the central management and monitoring of the facility.

- **Application Layer:** This layer focuses on specific applications that support various facility management tasks. It includes microservices for different user portals (Admin, Worker, and Employer) and a mobile app for on-the-go access. The layer also features a management system with modules for finance, HR, inventory, supply chain, customer relationship, sales, and project management. Additional features include data management, document and knowledge management, and e-commerce functionalities.

- **Interaction Layer:** This layer facilitates user interaction with the system. It includes user devices and a user interface, allowing various user roles (client, gig worker, and general user) to access the system. The layer also incorporates role-based access control and security measures such as SSL and VPN to ensure secure and authorized access to the platform. This layered architecture

ensures a robust and scalable system for managing facility operations, integrating various technologies and processes to enhance overall efficiency and performance.

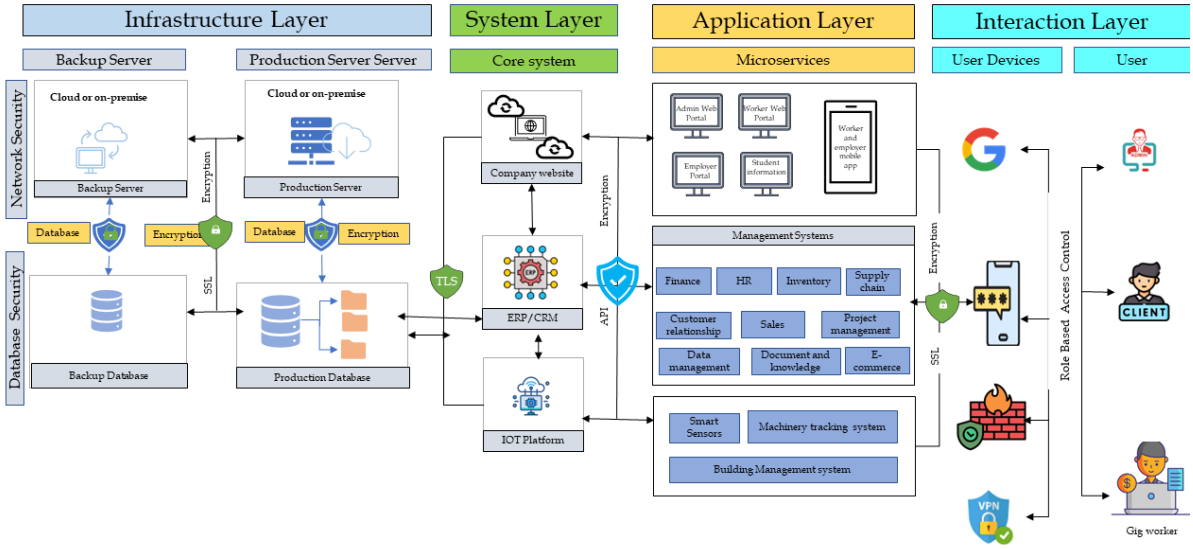

Figure 1: Platform based Facility Management System Architecture

- **Client App/Web Portal:** Service request submission (manual or IoT-triggered), real-time tracking, quote comparison/acceptance, vendor selection (algorithm-assisted), digital contract signing, service verification, payment initiation, rating/review.

- **Vendor App/Web Portal:** Profile management (skills, certifications, rates, availability), service request browsing/acceptance, route optimization/navigation, digital contract access, work reporting (text, photo, sensor data), invoice submission, payment receipt, client rating.

- **Admin Dashboard:** Platform monitoring, user management (onboarding/verification), vendor certification oversight, dispute resolution, KPI dashboards (efficiency, sustainability), pricing model management, system configuration.

- ***Core Platform Engine:*** The "brain" housing the AI/ML models for matching, pricing, routing, and predictive analytics. Manages workflows, data processing, and communication.
  IoT Sensors & BMS: Pulling real-time asset health and environmental data.

- **External Data Sources:** Traffic data (Google Maps API), weather forecasts, energy pricing.
- **Payment Gateways:** Integration with local mobile money (M-Pesa, HelloCash) and banking APIs.
- **Identity Verification Services:** (Potential future integration with national ID).

The BPMN (Business Process Model and Notation) diagram (Figure 2) illustrates a multi-faceted process involving three main actors: Gig Workers, a Platform Company (acting as a mediator), and Employers. The diagram is divided into three lanes, each representing a different actor, and outlines the steps and interactions between them (Bahrami et al., 2023). The diagram also indicates data flows (dotted lines) and control flows (solid lines) between different processes and actors. The use of pools and lanes helps to clearly define the responsibilities and interactions within the system. This BPMN diagram shows the process flow, interactions, and responsibilities between the different actors in the gig economy.

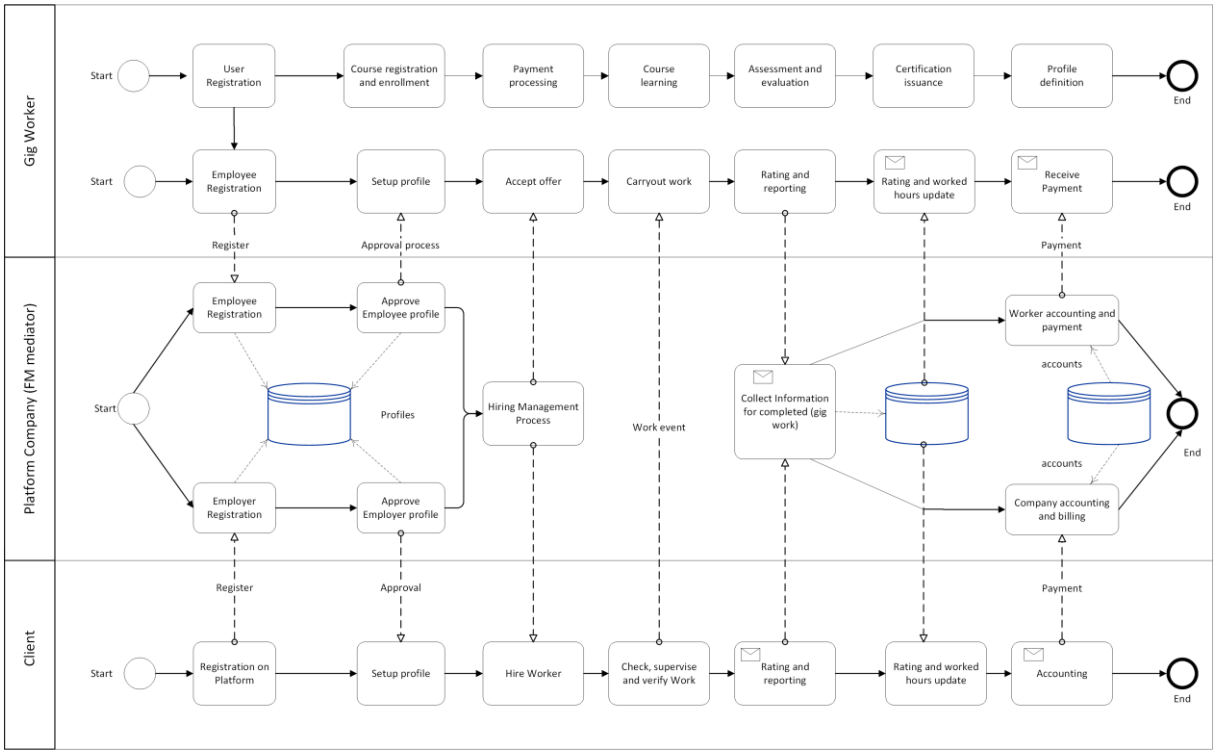

Figure 2: BPMN for platform based Facility management and Building maintenance

4.3. AI-Driven Optimization & Dynamic Allocation Engine (The Core Innovation)

Intelligent Service Matching & Allocation:

Inputs: Service Request (Type - plumbing, electrical, HVAC; Urgency; Location; Required Skills/Certifications; Client Preferences), Vendor Pool (Real-time Location; Skills/Certifications; Availability; Current Workload; Historical Performance Rating; Cost Profile; Client Ratings).

Algorithm: Multi-objective optimization algorithm (e.g., weighted scoring, constraint programming) balancing: Minimized Response Time, Minimized Cost (for client), Maximized Vendor Rating/Relevance, Maximized Vendor Utilization/Earnings, Geographic Proximity, Skill Match. Generates ranked shortlist for client selection or auto-assigns based on pre-set rules.

Real-Time Vendor Selection & Dynamic Pricing

Mechanism: Marketplace-driven pricing model. Base price influenced by service type complexity, standard rates. Dynamic adjustment based on real-time factors: **Demand-Supply Imbalance** (e.g., surge during rainy season for roof leaks), **Urgency Level** (client-defined priority), **Geographical Accessibility** (remote location premium), **Vendor Availability & Bidding** (optional feature for complex jobs). Provides transparency on pricing factors.

Intelligent Routing & Scheduling

Function: For vendors handling multiple jobs or platforms dispatching teams. Optimizes travel sequence considering: Job Locations, Job Durations/Time Windows, Real-time Traffic Conditions, Technician Skills (multi-skilled vs. specialist), Vehicle/Resource Constraints. Uses advanced routing algorithms (e.g., Vehicle Routing Problem solvers) to minimize total travel time/distance, reducing costs and emissions.

4.4. Predictive Maintenance Integration

Workflow: IoT sensors monitor critical assets (HVAC, elevators, generators). AI models analyze sensor data streams, identifying anomalies and predicting potential failures based on historical patterns and failure models. Automatically generates proactive service requests on the platform before breakdowns occur, specifying predicted issue and required expertise.

Technology Integration

- **IoT & Real-Time Monitoring:** Low-cost sensors deployed on critical assets for client control. Data transmitted via Low-Power Wide-Area Network (LPWAN) or cellular to the platform. Provides continuous health data for PdM and enables remote verification of work completion (e.g., confirming temperature normalization after HVAC repair).

- **Blockchain Implementation**

  Smart Contracts: Self-executing code deployed on a permissioned blockchain (e.g., Hyperledger Fabric for enterprise control). Automates: Service Agreement terms (SLA), Payment release upon client/vendor confirmation or IoT verification, Penalty clauses for delays/non-compliance.

  Immutable Records: Stores hashes of: Vendor certifications/licenses (verifiable credentials), Service History (work performed, parts used, costs), Client-Vendor Ratings & Reviews, Audit Trails. Ensures tamper-proof history for accountability and dispute resolution.

  Enhanced Trust: Provides transparency for clients on vendor track record and for vendors on payment guarantees.

Data Analytics & AI/ML Core

Centralized data lake storing all platform data (requests, transactions, sensor feeds, ratings). ML models continuously trained for: Improved failure prediction accuracy, refined matching algorithms, dynamic pricing calibration, identification of sustainability optimization opportunities (energy use patterns).

4.5. Workflow Automation (End-to-End Process)

- **Trigger:** Client submits manual request *or* IoT/PdM system generates automatic request.

- **Matching & Quoting:** AI Engine identifies suitable vendors, calculates dynamic price. Shortlisted vendors (or auto-assigned vendor) notified. Client receives quotes/assignment.

- **Booking & Contracting:** Client selects vendor/accepts assignment. Smart contract generated and digitally signed by both parties
- **Execution:** Vendor dispatched (optimized route if multi-job). Performs service. Logs details/evidence via app.
- **Verification:** Client inspects and confirms completion via app *or* IoT data confirms resolution or Hybrid. Photos/sensor data logged on blockchain.

To ensure data integrity and non-repudiation, a cryptographic hash is generated for the verification evidence (e.g., photos, sensor logs). This hash, which acts as a unique digital fingerprint, is logged on the blockchain alongside a timestamp. The actual files are stored off-chain in a secure database, while the on-chain hash provides a tamper-proof record for verification

- **Payment & Rating:** Smart contract triggers automatic payment release (escrow model). Two-way rating/review system activated. Performance data fed back into AI models.

4.6. User-Driven Ecosystem & Quality Control

- **Robust Rating System:** Multi-dimensional ratings (quality, timeliness, communication, cost-effectiveness) from both clients and vendors. Ratings heavily influence future matching and visibility within the platform.
- **Vendor Certification & Vetting***:* Rigorous onboarding process: Document verification (business license, trade certifications), background checks, skills assessment (potentially practical tests). Blockchain-stored verifiable credentials.
- **Performance Analytics & Tiering:** Vendors ranked based on performance KPIs (response time, completion rate, avg. rating, repeat business). Higher tiers get priority in matching and visibility.
- **Dispute Resolution Mechanism:** Clear, transparent process managed via platform admin, leveraging immutable blockchain records for evidence.

4.7. Sustainability Integration

Emission Reduction: Route optimization minimizes technician travel distances/times. Predictive maintenance prevents catastrophic failures requiring high-resource interventions.

Resource Optimization: IoT monitoring enables precise control of energy/water usage. Platform promotes vendors using sustainable practices/materials.

Reporting: Platform generates sustainability dashboards for clients (e.g., carbon savings from optimized routes, energy consumption trends).

5. Discussion: Implications, Challenges, and Mitigation

5.1. Potential Benefits

- **Operational Efficiency:** Dramatically reduced response times, optimized resource utilization (vendor time, travel), lower administrative burden via automation.

  * *Cost Reduction:* Competitive pricing through vendor marketplace, optimized scheduling/routing, reduced emergency repair costs via PdM, lower energy/water bills from optimized operations.

- **Enhanced Service Quality***:* Access to pre-vetted, rated vendors; Transparency drives accountability; Faster resolution times; Proactive maintenance improves asset reliability.

- **Increased Transparency:** Clear pricing breakdowns, visible vendor track records, immutable service history, open feedback loops.

- **Sustainability Gains:** Measurable reduction in carbon emissions (travel), optimized resource consumption (energy, water), extended asset lifespans.

- **Economic Empowerment:** Formalizes informal technicians, provides SMEs with access to a wider market, creates flexible work opportunities (gig model).

- **Smart City Alignment:** Provides the integrated data and efficient operations layer crucial for smart building and city infrastructure management.

5.2. Critical Challenges for Ethiopian Adoption

Platform Adoption & Digital Literacy

Adoption of the platform may face resistance from traditional vendors and clients, particularly due to low digital literacy among older workers and small businesses, a general lack of trust in digital systems, and a strong preference for familiar personal networks. To address these barriers, a phased rollout should begin with more digitally adept users such as large corporations and younger vendors. This should be supported by extensive training and support programs both online and offline along with pilot projects that clearly demonstrate cost and time savings. A user-friendly interface with support for local languages like Amharic and Oromo, coupled with an initial hybrid model that includes phone-based service requests, can further ease the transition, and build trust among hesitant users.

Regulatory & Policy Frameworks

The evolution of on-demand platforms raises regulatory concerns, including worker protection and data security, necessitating a framework for understanding their operational dynamics and implications for public policy (Popescu, 2024). Innovative models, provide insights into optimizing platform operations and understanding revenue dynamics, emphasizing the need for real-time data analysis (Dritsas, 2025). While on-demand platforms offer significant benefits to consumers and businesses, they also face challenges related to competition, regulation, and operational efficiency. The balance between these factors will shape the future landscape of on-demand services.

Implementing an AI-driven FM platform in Ethiopia faces key regulatory and workforce challenges. The absence of clear laws on digital labor platforms, liability ambiguity, underdeveloped data protection frameworks, and resistance from traditional industry bodies hinder adoption. Mitigation requires proactive policymaker engagement, advocacy highlighting economic and innovation benefits, clear platform governance aligned with emerging regulations, legal collaboration, and participation in regulatory sandbox initiatives.

Workforce-related barriers include limited digital skills, lack of IoT familiarity, job displacement concerns, and challenges integrating informal workers. These can be addressed through digital literacy and app usage training, partnerships with TVET

institutions, transparent communication on new opportunities, gamified learning, and a tiered system rewarding higher skill levels with premium rates.

Data Privacy & Security

The platform faces challenges related to sensitive data exposure such as building layouts, usage patterns, and financial records along with cybersecurity risks and a lack of mature data protection culture. Evolving regulatory requirements further complicate compliance. Mitigation strategies include implementing strong cybersecurity measures (encryption, access controls), establishing transparent data governance policies, enabling user consent mechanisms, and using blockchain for secure credentialing and service history. Adopting GDPR principles as a baseline and conducting regular security audits will further strengthen data privacy and regulatory compliance.

Initial Investment & Business Model Sustainability

High upfront costs for platform development, IoT integration, and marketing, along with uncertainty around revenue models and funding in a nascent market, pose major challenges. Demonstrating ROI to attract users is also critical.

Mitigation includes pursuing grants and venture funding, adopting phased implementation starting with an MVP, offering flexible pricing (e.g., tiered commissions), piloting to show ROI, and partnering with property managers as early anchor clients.

Standardization & Quality Assurance

Ensuring consistent service quality across vendors, standardizing service scopes and pricing, and preventing fraudulent ratings are key issues. Solutions involve strict vendor certification, clear SLAs, a standardized service catalog, rating fraud detection algorithms, a multi-dimensional review system, and mystery shopper audits.

6. Conclusion and Future Work

Summary of Key Findings

This paper addressed the critical gap in the digital transformation of Facility Management by proposing an innovative AI-driven platform model tailored for Ethiopia. By systematically reviewing best practices from thriving platform economies (ride-hailing, logistics) and nascent digital FM initiatives, we identified core success factors

AI-driven dynamic allocation, real-time optimization, transparent marketplaces, and user feedback loops and translated them into a comprehensive conceptual framework. The proposed **"Ethio-FM&BM Platform"** leverages AI for intelligent matching, pricing, and routing; IoT for real-time monitoring and predictive maintenance; and blockchain for trust, automation, and immutability. This integrated approach promises significant benefits: enhanced efficiency, cost reduction, improved service quality, greater transparency, sustainability gains, and empowerment of the FM workforce, directly supporting Ethiopia's smart city and digital economy aspirations.

6.2. Contributions

Theoretical: Bridges the gap between platform economy theory and FM practice; Provides a structured framework for applying cross-industry digital innovations to complex service domains; Advances understanding of digital transformation in FM within emerging economy contexts.
Practical: Offers a concrete roadmap for implementing a digital FM marketplace in Ethiopia; Highlights specific technologies (AI, IoT, Blockchain) and their integration points; Identifies actionable strategies to overcome adoption barriers; Provides policymakers with insights into regulatory needs.

Limitations: The model presented is conceptual and requires empirical validation. Findings are heavily reliant on secondary data for the Ethiopian context; primary data collection would strengthen contextual analysis. The model's scalability across diverse Ethiopian regions (urban/rural) needs further investigation. The focus is primarily on maintenance services; expansion to soft FM (cleaning, security) requires additional consideration.

7. Future Research Directions

- **MVP Development & Pilot Testing:** Design, develop, and deploy a Minimum Viable Product (MVP) focusing on core functionalities (matching, booking, payment, rating) for a specific service (e.g., plumbing) in Addis Ababa. Conduct rigorous pilot studies to measure KPIs (response time, cost savings, user satisfaction, emission reduction).
- **Ethiopian Context Deep Dive:** Conduct large-scale surveys and interviews with key stakeholders (building owners, facility managers, maintenance technicians,

policymakers) to gather primary data on needs, perceptions, and barriers specific to the Ethiopian FM sector.

- **Algorithm Refinement for Local Constraints:** Develop and test AI algorithms specifically optimized for Ethiopian infrastructure constraints (intermittent connectivity, data scarcity, traffic patterns) and market characteristics (vendor density, pricing sensitivity).
- **Business Model Validation:** Explore and validate sustainable revenue models (commission structures, subscription tiers, premium features) through market analysis and pilot feedback. Analyze platform economics thoroughly.
- **Integration & Scalability Studies:** Investigate integration with national systems (e.g., digital ID, tax systems) and other smart city platforms. Develop strategies for scaling the platform to secondary cities and rural areas, considering connectivity challenges.
- **Longitudinal Impact Studies:** Assess the long-term socio-economic impact of the platform on the FM workforce (income stability, formalization, skill development) and on building performance/sustainability over time.
- **Expansion to Soft FM & Integrated Services:** Research the applicability and adaptation of the model for soft FM services and explore synergies with integrated workplace management systems (IWMS).

Final Remarks

The digital transformation of Facility Management is not merely an option but a necessity for building resilient, efficient, and sustainable urban environments in Ethiopia and beyond. The proposed AI-driven platform model presents a viable pathway to overcome fragmentation and inefficiency, harnessing the power of digital technologies and platform economics. By embracing this future-proof approach, Ethiopia can position itself at the forefront of smart and sustainable facility management in Africa, unlocking significant economic, social, and environmental value. The journey requires collaboration between technology providers, FM professionals, policymakers, and academia to turn this conceptual roadmap into tangible reality.

References

Abdelalim, A. M., Essawy, A., Sherif, A., Salem, M., Al-Adwani, M., & Abdullah, M. S. (2025). Optimizing Facilities Management Through Artificial Intelligence and Digital Twin Technology in Mega-Facilities. Sustainability (Switzerland), 17(5). https://doi.org/10.3390/su17051826

Atta, N. (2021). FM paradigm shifts enabled by icts. In SpringerBriefs in Applied Sciences and Technology (pp. 37–39). Springer Science and Business Media Deutschland GmbH. https://doi.org/10.1007/978-3-030-62594-8_3

Azzran, S. A., Ibrahim, K. F., Tah, J. H. M., & Abanda, F. H. (2019). Assessment of open BIM standards for facilities management. In Innovative Production And Construction: Transforming Construction Through Emerging Technologies (pp. 247–259). World Scientific Publishing Co. https://doi.org/10.1142/9789813272491_0015

Bahrami, S., Nourinejad, M., Yin, Y., & Wang, H. (2023). The three-sided market of on-demand delivery. Transportation Research Part E: Logistics and Transportation Review, 179(August), 103313. https://doi.org/10.1016/j.tre.2023.103313

Barnes, R. L. (2013). Competencies, Credentials, Education, and Training. In International Facility Management (pp. 5–38). Wiley Blackwell. https://doi.org/10.1002/9781118771686.ch2

Brühl, V. (2023). Big Tech, the Platform Economy and the European Digital Markets. Intereconomics, 58(5), 274–282. https://doi.org/10.2478/ie-2023-0056

Chen, M., Zhao, D., Gong, Y., & Rekik, Y. (2022). An on-demand service platform with self-scheduling capacity: Uniform versus multiplier-based pricing. International Journal of Production Economics, 243(October 2021), 108329. https://doi.org/10.1016/j.ijpe.2021.108329

Clark, K. (2019). The human factor in change management Earn trust and show the benefits in building a case for CMMS. Plant Engineering, 40–43. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85174359648&partnerID=40&md5=2714910f2e8a7698a21ad9d69ea55d34

Clauss, T., Harengel, P., & Hock, M. (2019). The perception of value of platform-based business models in the sharing economy: determining the drivers of user loyalty. Review of Managerial Science, 13(3), 605–634. https://doi.org/10.1007/s11846-018-0313-0

Desbalo, M. T., Woldesenbet, A. K., Habtu, T. M., Bargstädt, H. J., & Yehualaw, M. D. (2024). BIM-enabled built-asset information management conceptual framework: A case of public university buildings in Addis Ababa, Ethiopia. Heliyon, 10(12). https://doi.org/10.1016/j.heliyon.2024.e33026

Durmus, D., Carbonari, A., Giretti, A., & Turk, Ž. (2025). EXPLORING CURRENT RESEARCH GAPS AND OPPORTUNITIES IN FACILITY MANAGEMENT FOR CONSTRUCTION. Journal of Information Technology in Construction, 30, 461–495. https://doi.org/10.36680/j.itcon.2025.020

Elmualim, A., & Gilder, J. (2014). BIM: Innovation in design management, influence and challenges of implementation. Archit. Eng. Des. Manag., 10(3–4), 183–199. https://doi.org/10.1080/17452007.2013.821399

Elmualim, A., Shockley, D., Valle, R., Ludlow, G., & Shah, S. (2010). Barriers and commitment of facilities management profession to the sustainability agenda. Building and Environment, 45(1), 58–64. https://doi.org/10.1016/j.buildenv.2009.05.002

Elnour, M., Ahmad, A. M., Abdelkarim, S., Fadli, F., & Naji, K. (2024). Empowering smart cities with digital twins of buildings: Applications and implementation considerations of data-driven energy modelling in building management. Building Services Engineering Research and Technology, 45(4), 475–498. https://doi.org/10.1177/01436244241239290

Eric Whitley. (2023). Digital Transformation in FM: Tools and Techniques for Effective Implementation. https://blog.ifma.org/digital-transformation-in-fm-tools-and-techniques-for-effective-implementation

Gunasekara, H. G., & Sridarran, P. (2021). Barriers in blockchain technology adoption for facilities management procurement process in Sri Lanka. Proceedings of the 37th Annual ARCOM Conference, ARCOM 2021, 371–380. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85118464917&partnerID=40&md5=8b9f30017c8335a47a43253839a7a25c

Hakimi, O., Liu, H., & Abudayyeh, O. (2024). Digital twin-enabled smart facility management: A bibliometric review. Frontiers of Engineering Management, 11(1), 32–49. https://doi.org/10.1007/s42524-023-0254-4

Haleel, A. J., & Dawood, L. M. (2023). Maintenance Scheduling Optimization using Artificial Intelligence Techniques: A Review. HORA 2023 - 2023 5th International Congress on Human-Computer Interaction, Optimization and Robotic Applications, Proceedings. https://doi.org/10.1109/HORA58378.2023.10156713

Kumar, V. (2023). Digital Platforms. In Management for Professionals: Vol. Part F1470 (pp. 331–393). Springer Nature. https://doi.org/10.1007/978-981-19-8148-7_4

Mazlan, S. F., Jabar, I. L., Ismail, H., Kaliwon, J., & Aksah, H. (2025). REVOLUTIONIZING FACILITY MANAGEMENT (FM): ADDRESSING INTERNET OF THINGS (IOT) ADOPTION CHALLENGES IN KLANG VALLEY. Malaysian Construction Research Journal, 24(1), 83–97. https://www.scopus.com/inward/record.uri?eid=2-s2.0-105004930631&partnerID=40&md5=21cdcbf529213133a17167512416c718

Mohammed, A. S., Amoah, C., Abbas, J., & Naayif, S. (2025). Facilities managers vs. mosque management committees: evaluating the need for professional facilities management in mosque operations. Facilities, 43(5–6), 363–396. https://doi.org/10.1108/F-07-2024-0102

Norliana, S., & Jay, Y. (2016). Interpretive structural modelling of people capability factors to promote sustainable facility management practices. Social Sciences (Pakistan), 11(12), 3005–3016. https://doi.org/10.3923/sscience.2016.3005.3016

Olimat, H., Liu, H., & Abudayyeh, O. (2023). Enabling Technologies and Recent Advancements of Smart Facility Management. Buildings, 13(6). https://doi.org/10.3390/buildings13061488

Power, C., Moore, O., & O'connor, R. (2024). Platform Cooperatives: An Organisational Model to Counteract Extractive and Exploitative Practices in the Platform Economy? In Economic Geography (Switzerland) (Vol. 2024, pp. 15–31). Springer Nature. https://doi.org/10.1007/978-3-031-53594-9_2

Radonjic-Simic, M., & Pfisterer, D. (2019). Beyond platform economy: A comprehensive model for decentralized and self-organizing markets on internet-scale. Computers, 8(4). https://doi.org/10.3390/computers8040090

Sampaio, R. P., Flores-Colen, I., & Costa, A. A. (2022). Discussion of digital transition impact in Facility Management of buildings. IOP Conference Series: Earth and Environmental Science, 1101(6). https://doi.org/10.1088/1755-1315/1101/6/062021

Sarpin, N., Kasim, N., Zainal, R., & Noh, H. M. (2018). A guideline for interpersonal capabilities enhancement to support sustainable facility management practice. IOP Conference Series: Earth and Environmental Science, 140(1). https://doi.org/10.1088/1755-1315/140/1/012116

Schmitter, P., & Ashworth, S. (2023). Digitally Transforming Facility Management in Healthcare: A Systematic Review of Key Digital Technologies and Systems. IOP Conference Series: Earth and Environmental Science, 1176(1). https://doi.org/10.1088/1755-1315/1176/1/012012

Sedhom, I., Khodeir, L. M., & Fathy, F. (2023). Investigating current practices for achieving effective participation of stakeholders in Facilities Management. Ain Shams Engineering Journal, 14(6), 102099. https://doi.org/10.1016/j.asej.2022.102099

Shuhaimi, A. M., Yusof, L. M., & Rahman, R. A. (2024). Drivers, capabilities, and challenges for adopting Digital Twin in Facility Management: a profound qualitative investigation. Planning Malaysia, 22(3), 589–606. https://doi.org/10.21837/pm.v22i32.1528

Støre-Valen, M., & Buser, M. (2019). Implementing sustainable facility management: Challenges and barriers encountered by Scandinavian FM practitioners. Facilities, 37(9–10), 550–570. https://doi.org/10.1108/F-01-2018-0013

Trigka, E. D. and M. (2025). Machine Learning for Blockchain and IoT Systems in Smart City. Future Internet, 17(2), 80. https://doi.org/10.3390/fi17020080

Twum-Bobie, A. N. Y., Issah, F. D., Alhassan, T., & Kidido, J. K. (2025). Facilities management practices in gated communities in Ghana: a study of selected gated communities in Accra. Property Management, 43(2), 322–339. https://doi.org/10.1108/PM-08-2024-0091

Wei, Z., Xiang, G., & Ma, X. (2012). Innovation culture, transformational capability and transformational performance: An empirical study of SMEs in China. 2012 International Symposium on Management of Technology, ISMOT 2012, 51–55. https://doi.org/10.1109/ISMOT.2012.6679427

Wessel, M., Thies, F., & Benlian, A. (2018). Competitive Positioning of Complementors on Digital Platforms: Evidence from the Sharing Economy. ICIS 2017: Transforming Society with Digital

Innovation. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85107082521&partnerID=40&md5=737ed8e89e04dacfea4179c3e5b9b628

Xu, Y., Ahokangas, P., Turunen, M., Mäntymäki, M., & Heikkilä, J. (2019). Platform-based business models: Insights from an emerging ai-enabled smart building ecosystem. Electronics (Switzerland), 8(10), 1–19. https://doi.org/10.3390/electronics8101150

Yang, Y., Umboh, S. W., & Ramezani, M. (2024). Freelance drivers with a decline choice: Dispatch menus in on-demand mobility services for assortment optimization. Transportation Research Part B: Methodological, 190(April 2024), 103082. https://doi.org/10.1016/j.trb.2024.103082

Science meets Practice:
Workplace Management

Mapping workplace characteristics against a backdrop of hybrid work life – An explorative comparison between office workplaces & home workplaces

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Abstract:

Digital transformation and a development coupled with effects on work from the pandemic has led to a work life with remote and distributed work and workplaces with employees dividing their work between a primary office and other places like the home, and sometimes also other locations, a so called "third place" or “hub”. Although this model of hybrid working is considered the definite future work structure it is debated. We find today a large group of office employees working at several locations, and of which one is their home. This being said, our study sets out to investigate: a) the effect of workplace design variations on employee performance, well-being and comfort, b) how design empowerment can utilize sense of control of the work environment as a motivator, and c) the balance between the acceptance for home workplace, and the back-to-the-office drivers.

Method

Investigating office employees' notion of their workplace/workplaces, we use a mapping tool that discern between functional and measurable effects, symbolic and metaphoric qualities, and the user’s own categorization. This is done by having office employees describe the characteristics of their different workplaces by marking them in a triangle model between nodes for the three different characteristics. Our analysis is based on interviews with office employees (*n*=17) of both genders from four organisations (two private, two public). The sample includes both regular employees, middle managers and people at higher position (*n*=2). Since most of the participants had only one external workplace—a home workplace, we focus on the comparison between this and the office workplace.

Findings

Office employees' preference for the home office is highly dependent on its ability to support practicalities in everyday life. At first glance this overshadows many other aspects of the home workplace, but when scrutinized a more complex picture emerges. In summary, our results indicate that the home workplace is mostly dependent on the user’s personal considerations and wishes. Wellbeing associated to home workplaces appears to relate to aspects like ownership, self-expression and control of the environment manifested in the varying designs of the home workplace applied by the users.

These preliminary findings suggest that understanding aspects of the design of workplaces and systemizing them could contribute to empowerment also in the organisation´s actual office workplace and hereby contribute to a more sustainable office working life.

Key words: *hybrid office working*; *home workplace*; *office workplace*; *workplace design; sense of control*; *empowerment*

1. Worklife and office work

The corona pandemic led to significant changes in the way work is executed and organised and increased development of digital applications and systems. This enabled and sanctioned work outside the office with a variety of organisational and spatial settings (Futorion 2021). It initiated a shift in work attitudes among employees and in the development of work routines, forms of employment and workplaces (Bodin Danielsson 2024). Continuing with a hybrid solution working partly from home and partly at the office or anywhere else, e.g., on travel, at the library, in a café or at a book-in workplace in the neighbourhood, is optional but also attractive to many, but not for all and not always. The hybrid workplace has come to stay, and in an era where severe cuts in global greenhouse gas emissions are of vital importance, it is crucial to understand its potential as a contributor for a greener urban development that includes social durability (health, well-being, and inclusion).

To understand the function of the future office workplace, and what it means out of a sustainable development perspective, knowledge of what consequences this may have for employees, organisations and society is needed. There has been little research on effects of home offices and businesses run with this as a spatial approach and this results in a gap underlying decision making on organisation and workspace design. More knowledge about the conditions for a successful implementation of a home office is necessary to be able to integrate it on the overall work situation for employees. After the pandemic the work at home option has been one solution to work life balance and planning (Flövik et.al. 2021). However, several companies consider ending remote work, citing the need to build culture, train newcomers and share knowledge. However, what impact the type of work, degree of collaboration, and workspace design or location have for employee satisfaction with hybrid solutions is still largely unknown.

There are also large knowledge gaps about to how extensive use of home offices affect employee health and well-being, work environment, comfort and productivity. Likewise, knowledge is sparse about what role the physical work environment of employee different workplaces in hybrid working life play for this specifically. We know when working from home aspects like commuting time, working life balance play are important, but what role the physical work environment plays for described factors as well as choice of workplace is not well-researched to our knowledge.

Well-being is closely linked to mental health, and WHO defines a healthy workplace as one which employees and managers collaborate to use a continual improvement process to protect and promote the health, safety, and well-being of all employees as well as the sustainability of the workplace. What this mean in a hybrid working life context when office employees spend a great deal of their working days away from the organisation´s office is not well researched. International Labor Organisation (ILO) has a broad understanding of workplace wellbeing; “(it) relates to all aspects of working life, from the quality and safety of the physical environment, to how employees feel about their work, their working environment, the climate at work and work organisation" (ILO 2022). Nevertheless, employee health and well-being in a hybrid office working life still today not well-researched, a few years (three years) after pandemic restrictions lifted in the Western countries. We do know that functional, aesthetical, and technical qualities of the workplace may have a preventive effect on stress and mental difficulties. Predictable working conditions, a sense of control over social interaction, light, temperature, noise, workstation design, views, and accessibility to green restorative environments outside the office are of great benefit to both employees and employers, benefits the home workplace potentially can offer more easily than most office workplaces. Office environments that prevent stress and promote mental health should be given greater attention by the parties in working life, because the prevalence of mental disorders is high in the population and is associated with large societal costs due to sick leave (Bodin Danielsson et.al. 2014.). Also, regarding other outcomes of relevance for a healthy, sustainable hybrid working life when focusing on the importance of the physical workplaces issues such as productivity and comfort are not researched in depth. The literature points to a lack of structured evidence-based knowledge about human-environment interaction to support decision making in office design in a hybrid work life context (Gjerland, Søiland, Thuen, 2019).

Given the knowledge gaps regarding the importance of the physical workplace for employees in a hybrid office work life, this exploratory study sets out to investigate different aspects important to the quality of workplaces, and do so with a focus on well-being, productivity and comfort.

2. Method

Data gathering

Interview responses were collected through group interviews and individual interviews. The group interviews were done at the companies and did also include a walk around the office/workplaces. All interviews were recorded and transcribed verbatim. The marking on the mapping model, the diagrammatic triangle, was done in conjunction with the individual interview. When the interviews were done digitally the respondent had printed versions of the mapping tool that they filled in and then scanned and sent to the researchers.

Study design with regard to the mapping tool and approach

In the present study a mapping tool for understanding aspects of design was used that originally was developed as a support in designing (Lindahl, 2001). The aim was to test if it also could have a descriptive use in a participative design process with end-users, in this context office employees

Sample

The mapping tool was used in studying workplaces in four organisations (two private, two public) from different line of business:

- A major international bank (Nordic and Baltic region)
- A computer game developer
- A municipal real estate owner, a municipal company
- A municipal planning unit, a municipal authority

All organisations in our study had so so-called activity-based flex-offices (AFO) (Wohlers & Hertel 2017, Bodin Danielsson 2008). Our sample consists of sixteen office employees (n=17, 9 men and 8 women) from the participating organisations. The sample includes both regular employees, middle managers (n=5) and staff at higher/managerial positions (n=2). Since most of the participants had only on external workplace—a home workplace the comparison in this exploratory study is between the home workplace and the office workplace, and not on other eternal workplaces.

The approach that was applied was the testing of an mapping model (triangle model) capable of describing the interdependencies between different aspects important to the quality of workplaces (henceforth model and mapping model will be used

synonymously). In Lindahl (2001) such a model is presented based on three aspects that were identified in workplace design research. They are as follows:

(1) The work environment aspects that have mainly to do with health and safety.

(2) The metaphoric and symbolic aspects of space.

(3) The personal configuration, which concerns an individual's, often unarticulated, preferences

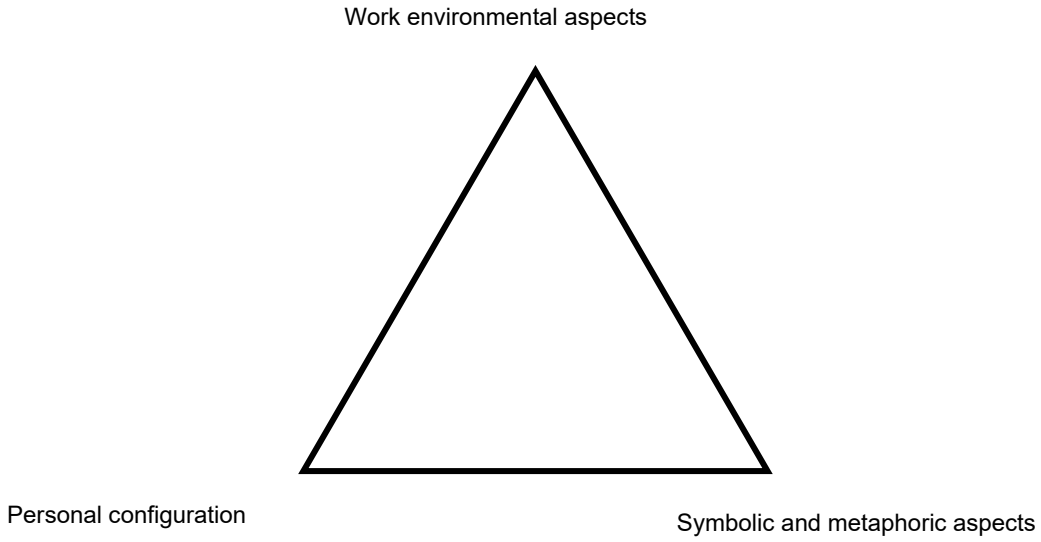

Figure 1. The mapping tool with the three aspects.

The three aspects all have different implications for workspace design.

1) *The work environment aspects* primarily affect health and safety. They also influence possible spatial designs and the functionality of workplaces. These are aspects of the work environment important for interaction and performance. Work environment qualities have received attention from researchers for several years, and there is a well-developed legislation regarding health and safety issues in working life. If, however, the work environment qualities are very poor, the focus at the place of work will predominantly be on carrying out the working tasks at their most basic level. This is likely to prevent the employees from contributing to the development of the organisation.

2) *The metaphoric and symbolic aspects* of space are a part of what is called "corporate image" and the identity of the company.

Branding by design is the use of a unique design, sign, symbol, or a combination of these, employed in creating an image that identifies an organisation/workplace, distinguishing it from others (Bodin Danielsson 2019). This aspect is about architectural design but also has input from other professional fields. The metaphoric aspects are supposed to direct thought and the symbolic qualities to direct action (Hatch, 1990). A metaphor such as the flexible office aims to engender a sense of flexibility among office occupants. Symbols of the flexible office such as equipment on wheels should make people act differently, e.g. in the daily use of workstations and workplaces within the premises. The starting point when discussing this aspect is that it must be related to use and appropriateness.

If a specific design has been found to be inappropriate in its context it will be regarded as “styling” and not related to the tasks that must be carried out in the specific workspace. Both the work environment qualities and the symbolic and metaphoric qualities of space are aspects that belong to the traditional work of architects, although the awareness of their effects and implications on design concepts is not always articulated or explicit (Lindahl, 2001).

3) The term *personal configuration* is used to describe the dynamic and contextual interdependence between the spatial setting, and the everyday actions carried out in the organisation. Individual configuration as it is used in the paper is an aspect that is developed within the organisation. It is rooted in the daily work. It cannot be articulated without participation from the individuals in the organisation. When discussing individual’s configuration, the experience of meaning and usefulness is important. Action is central to configuration. It is the action that creates meaning and relationships between individuals at work.

Although the workplace is a whole that to different degree holds the three aspects the figure can also be used to illustrate the relationships between the aspects, e.g. the more you focus the metaphoric and symbolic aspects the less you focus the work environmental issues. However, the relationships are not reciprocal, and the scales are different. The work environmental qualities are to a higher degree measurable than metaphoric and symbolic qualities, which are related to whether they are accepted or understood by the users or not. This is also true of the relationship between work environmental qualities and personal configuration. If the focus is on work environmental issues, it is likely that measurements of different qualities will be in

focus. If what is contextually understood as appropriate has been articulated by the users involved, the focus is likely to be on those qualities instead of the work environmental qualities. The relationship between configuration and metaphoric/symbolic qualities is one of correspondence. If the metaphoric/symbolic aspects correspond with what contextually is understood as appropriate configuration the two aspects will correspond. Furthermore, the aspects are not fixed. The aspects have a dynamic relationship to each other. It is important to note that there are no specific types of space, or qualities of these, that are connected to only one aspect. It is not a normative model where casual relationships are in focus. A good work environment can be aesthetically well designed or not. A supporting and satisfying workplace might be nor a good work environment or a stylish one.

3. Study focus

Our study investigates office employee's notion of their workplace/workplaces focusing on three themes and how they support or hinder the employees. These are:

1. Productivity
2. Well-being
3. Comfort

The respondents were asked at the interviews to mark in their answers to five questions, see below, in the mapping model. The first two were general questions and the three last ones related to the themes above. The questions were:

A. What is the focus of your workplace design today
B. What should the focus of your workplace design ought to have been
C. Where in the mapping tool should the focus be to support productivity
D. Where in the mapping tool should the focus be to support well being
E. Where in the mapping tool should the focus be when designing to support comfort

The form can be seen in figure 2 below.

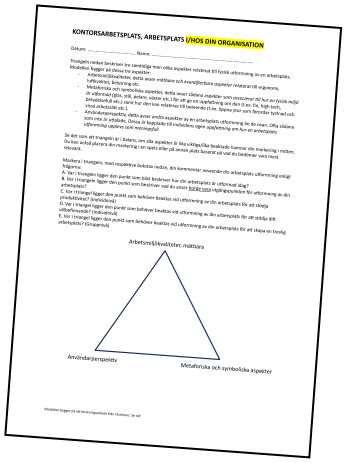

Figure 2. The actual document each person filled in and marked on [in Swedish, showed here as an illustration] This one concerns the workplace in the organisation. The one for the workplace in people's homes was identical.

The respondent's markings in the mapping tool were complemented by individual in-depth interviews with the participants.

4. Findings

Studying the distribution of comments/answers on the questions in the mapping tool, and focussing the three themes above, each theme can be illustrated/described in the mapping tool. The findings section describe distribution of markings as illustrated in the below figures. These illustrations represent the main office workplace and the home workplace. The colours represent different individuals, which is not analysed or discussed here.

Productivity

The mapping tool gives this illustration that visualizes that the office workplace, with more markings in the center, is designed with all three aspects in mind. While the office at home gets a more distributed illustration for the theme productivity. This can be seen as an indication and a confirmation of the requirement, also noticed in interviews, to allow for more individual applications and designs at home. In this case also the personal configuration is noticeable.

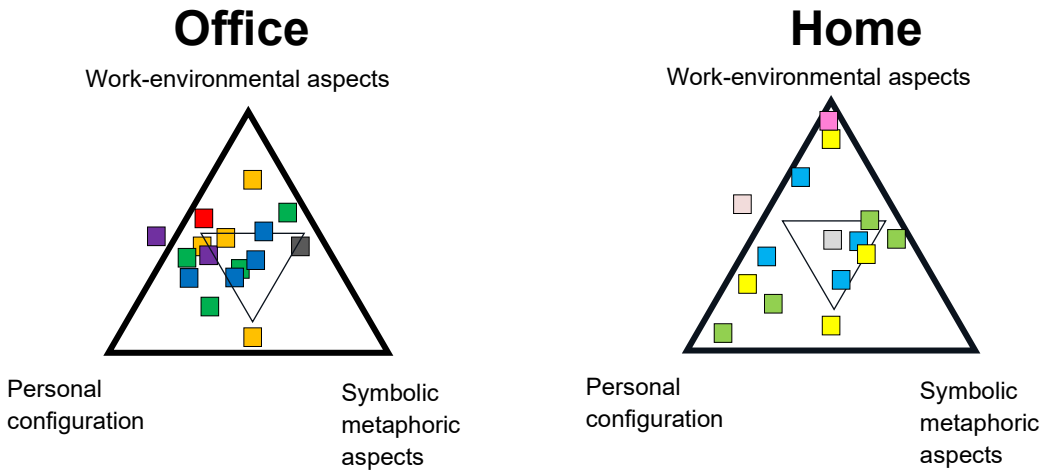

Figure 3. Productivity, theme 1, as illustrated in the mapping tool.

Quotations from the interviews describe the office as “a cleaner place with coffee and toilets” and that there are proper desks, chairs etc. In contrast to the home workplace where this is one’s own responsibility to organise and arrange for coffee and breaks. A recurring comment on the office is that one is thrown out of “task context” [manager at the bank] and need to start over again. At the same time the office is a good place to get to know colleagues so that one then can work together remotely [designer of computer games].

Well-being

Well-being associated to home workplaces appears to relate to aspects like ownership, self-expression and control of the environment manifested in the varying designs of the home workplace applied by the interviewees. The possibility to sit where one like is an important aspect, an important daily choice.

The mapping tool gives the illustration below where it can be seen that symbolic and metaphoric qualities are more present in the home workplace. It also shows a somewhat higher focus on personal configuration and symbolic and metaphoric aspects than concerning theme 1, productivity. This can also be seen as an indication of the importance of correspondence, as mentioned above, between individual configuration and symbolic and metaphoric aspects.

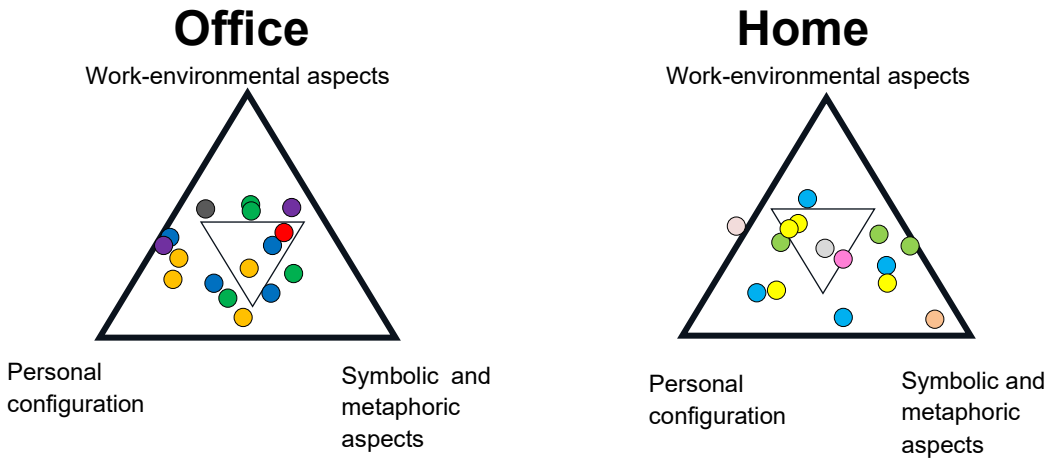

Figure 4. Well-being, theme 2, as illustrated in the mapping tool.

Quotations from the interviews describe well-being at the office related to environmental factors and elements like noise, sound, furniture and glass walls, aspects that are also relevant for work environmental aspects. The latter, glass walls, a common design feature in contemporary offices design, independent of applied office type, is commented with regard to well-being as that it is “not useful at all to fight noise”. But also, the possibility to choose where to sit is noted here in relationship to well-being, one respondent stated that being able to use a two-person room by oneself room was desirable. One comment was that this also indicates the need among staff for single person rooms. We see here a combination of comments on actual work environmental factors with factors related to status, how one visualises oneself in the organisation etc. Also, the possibility to exercise was mentioned here as a quality. This comment though,was related to the larger bank that incorporate training facilities and rather reflects size of organisation. Comments in the interviews on the workplace at home concern that “I can also relax and recuperate during the workday” [computer game company] and “I can be more spontaneous and go for lunch walks” [bank], but also that one can be “distracted by domestic responsibilities” [municipal real estate organisation].

Comfort

The mapping tool gives this illustration, indicating that the office should consider all aspects in a balanced way whereas the home context is very distributed, and probably reflects to a high degree individual preferences.

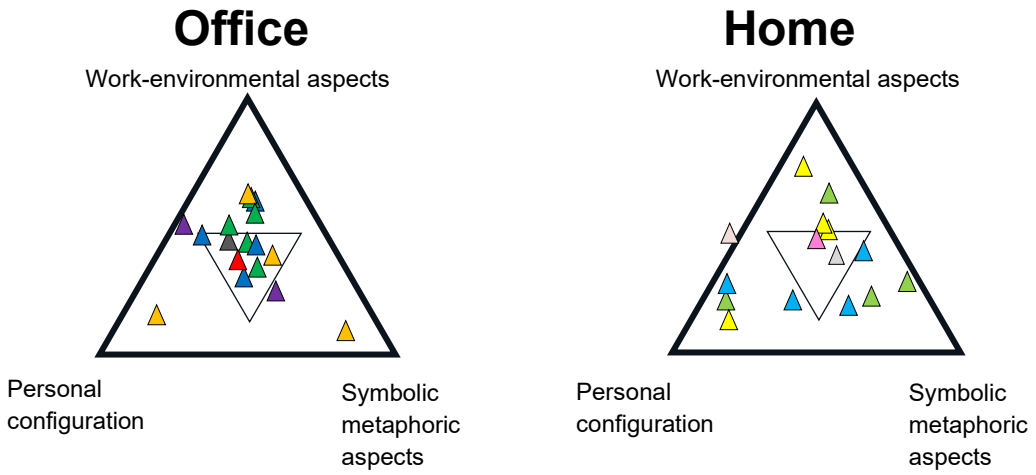

Figure 5. Comfort, theme 3, as illustrated in the mapping tool.

Quotations from the interviews describe freshness, coffee and social areas at the office. One respondent, however, stated that “there is nothing I like with the office” commenting that there were a lot of nice features like cafés, playrooms etc but not enough desks for the actual work. Also noted was what was called “social stress”. The home workplaces on the other hand were generally not commented with regard to comfort, they were accepted as they were.

5. Interpretation of the results

Based on interviews and markings in the mapping tool we were curious to see if we could understand better office employee’s notion of their different workplaces in hybrid working life – with access to at least two workplaces- the home and office workplace. And if this notion is possible to describe by a mapping tool that investigates different aspects of the workplace as a whole made up by: 1) work environment aspects, 2) symbolic and metaphoric aspects, and 3) personal configuration. If so, is a certain aspect more represented in the notion of one or the other workplaces, i.e. the home workplace or office workplace with regard to support or hindrance for the three themes investigated - productivity, well-being and comfort.

When we study the mapping tool and the three aspects alongside each other we see that the theme productivity has an emphasis on the left side of the tool, i.e. along the side between work environmental aspects and personal configuration. This applies to both the office workplace and the home workplace, although a lesser concentration (less markings in the center of the mapping tool) can be noted for the office.

The theme well-being has a focus closer to the aspect personal configuration when mapping the office workplace. For the home workplace the markings in the tool are distributed between personal configuration and symbolic/metaphoric aspects.

With regards to the theme comfort there is a clear focus in the middle of the tool, interpreted as a more neutral stance, implying that this theme is balanced. Looking at the office workplace, this theme is clearly in the center and looking at the home workplace it can be noted that the markings are slightly more positioned between personal configuration and symbolic/metaphoric aspects.

The interviews showed that employee notion of their different workplaces and preferences is today, after the pandemic, highly dependent on the workplace´s ability to support practicalities in everyday life. In this regard the home office was preferred over the office workplace by most of the participants. At first glance the home workplace support of daily practicalities overshadows many other aspects of the home workplace, but when scrutinized a more complex picture emerges. A picture where the ability to express oneself and to have a workplace one controls is shown to be of importance. The workplace at home is one's own creation and that overrides many other requirements of a safe and well-designed workplace.

Office employees´ considerations regarding their office workplaces had environmental demands at focus, primarily disturbances by noise and colleagues interrupting. The offices, all being activity-based flex-offices (AFOs), were designed for flexible use with non-personal workstations, required employees to plan ahead, e.g. to be sure to find an available room for focused work when needed. However, open workspaces were not always used as intended. Effective use of participants´ offices required certain behaviours, which only became a negative factor, when compared to working from home—a situation that was once considered an exception.

Focusing on the physical workplace and the comparison of employees´ home and office workplace¬ findings based on the mapping tool suggest that understanding aspects of the design of workplaces and systemizing them could contribute to empowerment also in the organisation´s office workplace and not only the individual employee´s home workplace. Our findings suggests that personal control plays a central role. To challenge this self-control may be formally legitimate but also entails a risk of framing work life in a way that affects long term outcomes on productivity and

staffing. Thus, we need to understand office workers' perceptions of workplace qualities at their various workplaces, and hereby preferred choices. This may contribute to a more sustainable balance between different workplaces in a hybrid context. For the purpose of this exploratory study, we have found the utilization of the mapping tool interesting and useful. This being said, the mapping tool is foremost useful in the design process — rather than after implementation—to design more attractive and supporting workplaces.

It is clear that controlling to what degree one can be allowed to be disturbed is crucial, this is commented recurringly. Both with regard to actual noise etc. but also related to social interaction and hindrance of task focus.

As noted by Tuzcuoglu et.al (2025) staff seems to be less critical of actual workplace design when there is a choice between an office and a workplace at home. Again, the importance of being able to choose becomes evident. This is something observed also in this study.

It is clear from the analysis of the data underlying this paper that being able to choose qualities of one’s workplace, to be able to be a person with identity reflected in the workplace, whether at the office or at home, is important. The office workplace is not just a functional support.

6. Conclusion

With the dramatic shift toward hybrid working, studying these new patterns is essential for informed decision-making and workplace design. Ongoing resource and staffing challenges, along with pressures on the office real estate market affecting commuting and urban planning, make understanding the future of workspaces increasingly important—not just for the real estate sector, but for society as a whole, including public policy and labour market regulations.

Given this, we investigated how office employees experienced support of productivity, well-being, and comfort across different workplaces in a hybrid working, through in-depth interviews on the subject and with the support of a mapping tool that describe employee perception of work environment, symbolic and metaphorical and personal configuration at their home and office workplace.

To conclude, our exploratory findings suggest that understanding aspects of the design of workplaces and systemizing them could contribute to empowerment also in the organisation´s actual office workplace and hereby contribute to a more sustainable office working life. Or a more sustainable balance between different workplaces in a hybrid context. This is important not just to employees but also to management andHR when aiming to support output and business objectives.

For architects and designers, it implies a need to further understand drivers related to business, and working life. Not as a style but as an expression of a hybrid work approach.

References

Bodin Danielsson, C. (2008). Office experiences. In H. Schifferstein & P. Hekkert (Eds.), Product experience (pp. 605-628). Elsevier Scientific Publications, Netherlands.

Bodin Danielsson, C. (2019). Shaping Factors - Shaping Contemporary and Future Office Design. Nordic Journal of Architectural Research, 2.

Bodin Danielsson, C. (2024). A different office working life (Eng. Short version). Report Areim_Eng Short version: "A study about a different office working after the pandemic with increased remote work after the Corona pandemic, *https://www.areim.se/a-different-office-life-a-study-about-the-changed-office-landscape/*, pp.1-23

Fløvik, L., Lunde, L-K., Vleeshouwes, J., Johannessen, H.A., Finne, L.B., Mohr, B., Jørgensen, I.L., Christensen, J.O. (2021) Arbeid hjemmefra, helse og arbeidsmiljø. En systematisk kunnskapsoppsummering. STAMI-rappor

Futurion. (2021:2). Flyttmönster i ett förändrat arbetsliv - signaler som visar hur vi ser på att bo och jobba i framtiden (Eng. Moving patterns in a changed working life - signals of future living and working). Futurion Report, 2, 1-33. (https://futurion.se/ny-rapport-flyttmonster-i-ett-forandrat-arbetsliv-en-signalskanning/)

Gjerland A., Søiland, E. & Thuen, F. (2019). Office concepts: A scoping review. Building and Environment, 163, 106294

Hatch, M.J. (1990), “The symbolics of office design: an empirical exploration”, in Gagliardi, P. (Ed.), Symbols and Artifacts; Views of the Corporate Landscape, Walter de Gruyter, New York, NY.

ILO (2022). Workplace well-being. https://www.ilo.org/safework/areasofwork/workplace-health-promotion-and-well-being/WCMS_118396/lang--en/index.htm

Lindahl, G. (2001) The innovative workplace: an analytical model focusing on the relationship between spatial and organisational issues. Facilities. Volume 22, Number 9/10, 2004.

Tuzcuoğlu, D., Appel-Meulenbroek, R., Borgers, A., Arentze, T., Sungur, A. (2025) Home or office? The impact of home and office attributes on workplace decisions in hybrid working,

Building and Environment, Volume 282, 2025, 113254, ISSN 0360-1323,https://doi.org/10.1016/j.buildenv.2025.113254.

Wohlers, C., & Hertel, G. (2017). Choosing where to work at work–towards a theoretical model of benefits and risks of activity-based flexible offices. Ergonomics, 60(4), 467-486. *https://doi.org/10.1080/00140139.2016.1188220*

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