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Digitisation and Women Architect Entrepreneurs in the PCMC Area: A Secondary Data-Based Exploratory Study of Opportunities and Challenges

Ar. Bhagyashree Apte*

*Professor at S. B. Patil College of Architecture and Design, Nigdi, Pune. Email Id: b.apte@sbpatilarchitecture.com

Abstract

Digital technologies are transforming architectural practice by reshaping design delivery, visualisation, client communication, and business operations. In this evolving professional environment, women architect entrepreneurs encounter both expanded opportunities and emerging barriers linked to digital adoption. This study examines the impact of digitisation on opportunities and challenges faced by women architect entrepreneurs in the PCMC area. It adopts a secondary data-supported exploratory approach and draws on scholarly literature, institutional sources, and industry evidence related to digital transformation, architectural practice, and women entrepreneurship. The findings indicate that digitisation supports professional visibility, client engagement, design presentation, operational efficiency, market reach, and flexible work practices. Tools like CAD, 3D visualisation software, digital marketing platforms, online communication systems, and virtual collaboration tools help women-led architectural practices improve competitiveness and business responsiveness. The study also shows that advanced digital adoption remains limited due to high software costs, inadequate technical training, rapid technological change, limited institutional awareness, and weak access to structured support systems. The study emphasises the need for affordable software access, targeted digital skill development, mentorship, professional networking platforms, and stronger policy outreach. It contributes to business and management literature by linking digitisation, gender, entrepreneurship, and professional service performance within a rapidly urbanising regional context.

Keywords: Women entrepreneurship, Digitisation, Architectural practice, Digital adoption, Business performance, PCMC

Introduction

The architecture, engineering and construction (AEC) sector has undergone a significant transformation as a result of the fast-paced growth of digital technology, as it affects the way architecture is designed, projects are coordinated, how communication happens and how business is delivered. While the architectural practice, in the past, developed from the classic drawing board, most of the coordination was done manually, today it has evolved into a digitally enabled architectural practice with computer-aided design, building information modelling, visualisation platforms, information/ communication technology (ICT) collaborative systems and online project communication systems. These technologies help in the exchange of information, decision making, accuracy of design and coordination in project execution at a higher speed (Arayici et al., 2011; Ahuja et al., 2009). Of these, BIM has evolved into a strategic tool that can be utilised in the integration of information from design, construction and facilities; technical skills, preparedness and funding capability are key to the successful implementation of BIM (Azhar, 2011; Succar, 2009). In rapidly expanding cities, digitisation is especially relevant in view of the real estate sector's expansion, the infrastructure and digital governance of cities, as well as the expectations of clients regarding architectural services. In such a situation, the architectural practice must be responsive and articulate design options, interact with a wide range of stakeholders and be competitive. This is achieved through digital technologies that lead to better documentation, visualisation, knowledge sharing and workflow integration. Innovation, knowledge management and technology transfer are closely associated with digital transformation in the architecture and construction industry in small and medium enterprises (SMEs) (Egbu, 2004; Sexton & Barrett, 2004). But it is a question of whether or not these technologies can be adopted and used based on the size, financial resources and training and contacts of the firm. Female architect entrepreneurs are a significant population in this changing employment environment, but one that is not well-understood. Though there is a positive shift in the representation of women in the architectural education and employment process, structural and social factors are impeding their representation in leadership, ownership and entrepreneurial positions (Dainty et al., 2000). These include restricted access to capital, fewer professional networking opportunities, gendered expectations, mobility issues and credibility issues when working in the construction and architectural industries as a female (Loosemore & Galea, 2008). The constraints might be exacerbated by socio-cultural norms and

disparities in institutional aid in developing world settings (Ahmad & Abdullahi, 2025). By digitising, women architect entrepreneurs get new opportunities like working remotely, communicating with clients online, digital marketing, virtual design presentations, and flexible project management. This can help women-led enterprises to become more visible and engage with customers and minimise the need for physical networking spaces.

One of the success factors of the Women Entrepreneur in the Architecture Industry is Technology adoption, which helps their business to grow and get customers, provide efficient services, and even get market competition (Mittal & Bhandari, 2021). Similarly, women entrepreneurs can exploit the use of digital technologies to scale up their businesses as market access, financial resources and strategic capabilities are available in the process of digital adoption (Orser & Riding, 2018; Kapoor, 2024). There are also new challenges of digitisation in the meantime. These technologies include BIM, 4D modelling, integrated project management tools and simulation platforms, which all need to be invested in to acquire licensed software, hardware, training and constant upskilling. Such expenditures may be an obstacle for small and women-led architectural firms to make the transition from digital use to digital transformation. Studies on BIM adoption reveal that it is a process that involves a clear roadmap, organisational learning, process restructuring, as well as commitment (Khosrowshahi & Arayici, 2012; Gledson & Greenwood, 2017). Therefore, the digital adoption should not only be considered as a managerial and strategic process, but also a technical process.

The context in which these issues can be discussed is relevant to the PCMC region because of its fast-paced urban growth, the high concentration of construction and building activities, the presence of smart city initiatives, Digital governance mechanisms and a high demand for architectural services. The entrepreneurial women architects in this region are working on the nexus of urban development, professional practice, technology adoption and gendered entrepreneurship. While digital tools can benefit their design delivery, client communication, visibility and flexibility, these may be hindered by a lack of training, funding, mentoring and more sophisticated digital systems to get the full benefit to their business (Ahuja et al., 2009). The research on digitalisation in AEC focuses on digital readiness and competence to ensure meaningful outcomes of technological applications (e.g., Brozovsky et al., 2024; Chen et al., 2024). The overall literature on AEC also suggests that digital technologies have revolutionised project management and the manner in which people work and collaborate in the AEC industry (Manzoor et al., 2021).

Hence, in the context of this study, the aim is to explore the effect of digitisation on opportunities and challenges of women architect entrepreneurs in the PCMC region. Specific aims are to understand the adoption rate and type of digital tools, the opportunities afforded to women-led architectural practices in the digital transition, to understand the financial, technical and skills-based barriers which affect digital tool adoption, and to understand the impact of digital tool adoption on client acquisition, visibility, operational efficiency, work-life flexibility and business performance. The study also attempts to suggest some of the facilitative measures which can be taken to enhance the inclusive digital participation of women Architect entrepreneurs.

Objectives of the Study

1. To examine the adoption and use of digital tools among women architect entrepreneurs in the PCMC region
2. To analyse the opportunities created by digitisation for women-led architectural practices, including business growth, visibility, and flexibility
3. To identify the financial, technical, and skill-based challenges affecting digital technology adoption among women architect entrepreneurs

2. Research Methodology

2.1 Research Design

The present study is descriptive in nature, whose design is exploratory and based on secondary data, which is used for understanding the role of digitisation on women architect entrepreneurs' opportunities and challenges in the PCMC area. This study is based entirely on secondary data. This design can be used to identify the general tendencies, problems and connections in the areas of digitisation, women entrepreneurship and architectural business practices.

2.2 Nature of the Study

This study is descriptive and analytical. It is an explanation of the digitisation process in architecture and the impact that digitisation has on business visibility, acquiring new clients, efficiency, competitiveness and work-life balance. It also takes a look at the obstacles that prevent effective digital adoption, such as software costs, training options, institutional support, digital literacy/skill gap and monetary factors.

2.3 Data Sources

Credible sources that are secondary are used. Such as MSME annual reports, publications of the MSME ministry, statistics of the Council of Architecture, digital governance and smart city reports, digitisation reports by AEC/construction, women entrepreneurship reports and literature from peer-reviewed journals. These are trustworthy sources to be able to grasp the overall perspective of women-

headed architectural firms and Digital transformation.

Table 1: Secondary Sources Used for the Study

Source type	Reference/citation	Purpose in study
Government press release	Press Information Bureau (2024)	Supports official context on COA–Autodesk collaboration and capacity building.
Professional council data	Council of Architecture (2026)	Supports architecture education/professional statistics, and institutional context.
Industry report/blog	Autodesk (2023)	Supports discussion on construction digitisation and BIM/digital transformation in India.
Smart city / local governance record	Pimpri Chinchwad Municipal Corporation (2016)	Supports PCMC smart city, digital governance, and urban development context.
MSME publications	Ministry of Micro, Small and Medium Enterprises reports	Supports MSME enterprise context, policy background, and women-led enterprise analysis.
Academic literature	Peer-reviewed BIM, women entrepreneurship, and AEC digitisation studies	Provides a scholarly foundation and validates research arguments.

Table 2: Women-Owned MSMEs in Maharashtra

Indicator	Maharashtra Data
Total women-owned MSMEs registered under Udyam	8,34,774
Micro enterprises	8,25,120
Small enterprises	9,082
Medium enterprises	572
Employment generated	32,79,075
Investment	₹18,338.39 crore
Turnover	₹2,51,357.15 crore

Source: *PIB report on Women Entrepreneurs in MSMEs, Annexure-II, Maharashtra row*

This table provides the state-level secondary data context for understanding women-led entrepreneurial activity in Maharashtra, within which women architect entrepreneurs in the PCMC region operate.

2.4 Key Variables and Indicators

Digital adoption, business performance, entrepreneurial challenges and institutional support are the key factors that are considered in the study. Digital adoption is explored by considering the use of CAD, 3D visualisation tools, BIM, digital marketing, online communication and project management software. The business performance is evaluated by means of the market coverage, client interaction, operational efficiency, impact on the revenue and competitive advantage.

2.5 Method of Analysis

The study is carried out in the form of Comparative Analysis, Thematic Interpretation and Tabular Presentation. Comparative tables on digital adoption trends, women entrepreneurs' adoption issues, and policy support frameworks, etc., and the relevance of digital tools for architectural practice could be presented. Where reliable secondary data in terms of numbers exists, graphs and figures may be used.

2.6 Scope of the Study

The study is done on the women entrepreneurs of Architecture and the impact of digitisation and

various challenges faced by women as entrepreneurs and professional development of women in Architecture, with a focus on the PCMC area. It's meant to be a conversation around digital solutions, business development, client relationships, marketing, efficiency and support.

2.7 Limitations of the Study

The major problem is that there are no field data. Consequently, the results can only be considered as a tentative set of suggestions and not as an empirically valid study. It makes use of credible secondary sources, which make the study academic, valid and applicable.

3. Results

3.1 Basis of Result Presentation

This section presents findings based on available secondary and institutional data. The results are grouped under 4 pillars: the adoption of digital, opportunities of digitisation, challenges of digitisation and policy/support needs.

3.2 Digital Adoption among Women Architect Entrepreneurs

The results reveal that all the available secondary sources indicate are adopting digital. “Secondary evidence suggests widespread use of digital tools in their architectural work. It is no longer an add-on function, but has become a part of the operation. In the field of architecture and architectural entrepreneurship, today there are close connections between the use of digital tools and the preparation of the design, visualisation, communication with the client, as well as with the visibility of the business and competitiveness on the market.

Table 3: Adoption of Digital Tools in Architectural Practice

Digital Tool / Practice Area	Reported Adoption	Result Interpretation
Use of any digital tool	100%	Complete digital penetration
CAD and 3D visualisation tools	100%	Core design tools fully adopted
Digital marketing tools	71.40%	Moderate-to-high use for visibility
BIM/project management software	0%	No advanced enterprise-level adoption
Simulation / Enscape-type tools	14.30%	Very limited high-end adoption

The results show that the basic design digitisation and advanced digital transformation are distinct. CAD and 3D visualisation software are fully adopted, whereas BIM and project management software are not adopted. The implication is that the architectural firms in the study that are led by women are ‘digitally active' and appear to be more interested in the design and presentation tools rather than integrated project-management platforms. This finding fits with the general AEC-sector conclusions that digital transformation can result in increased efficiency, requires investments, training and scalability. As for India, businesses are investing more in new technologies, but to implement these technologies, there is a need for structured change management and outcomes to be measured, as mentioned in the construction digitisation report by Autodesk.

3.3 Duration and Proficiency of Digital Adoption

The length of time of the adoption of digital tools demonstrates that most of the respondents' digital adoption was a slow process, as opposed to the start of practice. Some available data indicate that they had started using the digital tools immediately, while some 71.4% responded that they had implemented the digital tools gradually. This implies that there is an adaptive digital transition pattern.\

Table 4: Digital Adoption Stage and Proficiency

Indicator	Result
Gradual adoption of digital tools	71.40%
Adoption from the beginning of practice	28.60%
reported digital competency trends Level 4	71.40%
reported digital competency trends Level 5	14.30%
reported digital competency trends Level 3	14.30%
Level 1 or 2 proficiency	0%

The results of the tests of digital competency show that the respondents' digital competence level is average to good. This ability has been mostly linked to the use of simpler design applications and not to the more complex systems such as BIM, integrated project management or business tools based on analytics.

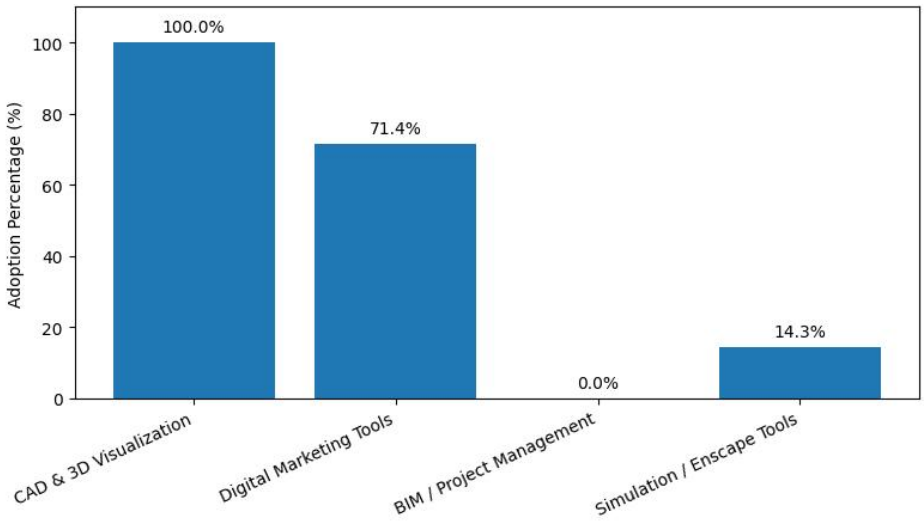

Figure 1: Adoption of Digital Tools

3.4 Business and Financial Results

The financial impact of digitisation is beneficial and moderate. Only 14.3% said that they had experienced a significant increase in revenue, 42.9% literature suggests experienced a moderate increase, and 42.9% said that there was no change in revenue.

Table 5: Financial and Business Impact of Digitisation

Business Indicator	Result	Interpretation
Significant revenue increase	14.30%	Limited high financial gain
Moderate revenue increase	42.90%	Digitisation supports incremental growth
No revenue change	42.90%	Benefits are not automatic
Business generated through digital channels up to 40%	85.80%	Digital platforms are supplementary
Do not regularly invest in digital upgrades	57.10%	Financial constraints limit continuity

The results of this show that although digitisation does help in developing the business, it does not help in a transformational way in increasing revenue. Digital appears to be an extra manner of doing business and not a significant cash spinner. Important for IJBMS as it means there is a disconnect between using the digital and business performance.

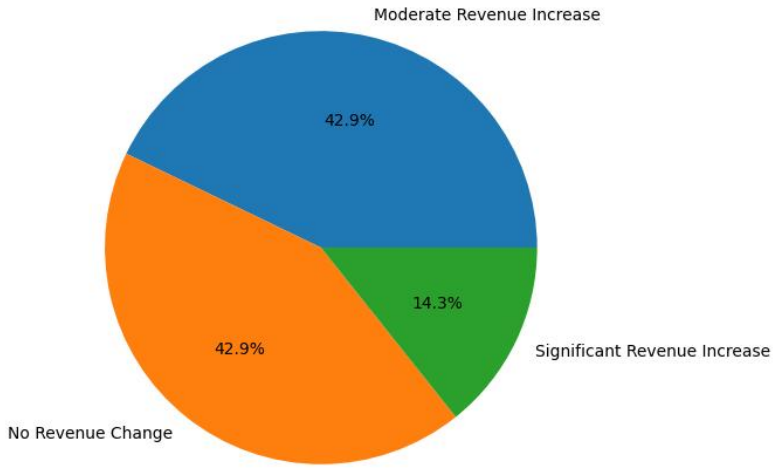

Figure 2: Revenue Impact of Digitisation

3.5 Challenges Associated with Digitisation

The results indicate cost and training to be the most significant obstacles. High software cost was cited as a problem by reviewed evidence, and lack of training and rapid technological change were cited by 85.7% of the respondents.

Table 6: Challenges in Digital Adoption

Challenge	Reported Result	Severity
High software cost	100%	Very high
Lack of training	85.70%	High
Rapid technological change	85.70%	High
Cybersecurity concerns	Moderate	Medium
Work-life boundary issues	Moderate	Medium
Staff resistance	Low	Low

The findings showed that the obstacles to implementing a business continuity plan are more of a financial and skill issue, rather than an organisational issue. This is particularly the case with women-led small architectural firms where expensive licensed software, hardware, subscriptions, and training can be stumbling blocks to adopting more sophisticated tools, such as BIM and project-management software.

3.6 Policy Awareness and Institutional Support

The results indicate there is not much policy awareness. 100% said they were unaware of any Government initiatives or that they were benefiting from them in the digital space. This is important as there are already Government schemes for MSMEs owned by women. According to the PIB data, women entrepreneurs are 20.5 per cent amongst the Udyam registered MSMEs, provide 18.73 per cent employment and 10.22 per cent turnover of the total of Udyam registered MSMEs. The same source provides support for procurement preference, guarantee-fee concession, additional credit guarantee coverage, training support, and subsidy on ZED certification for the women-owned MSMEs.

Table 7: Support Required for Improved Digital Adoption

Support Required	Identified support requirement
Subsidized software	85.70%
Digital skill training	85.70%
Networking platforms	71.40%

It is found that women architect entrepreneurs need focused assistance on three points, such as affordable software, structured skill development and a professional networking ecosystem. Since the study is based on secondary sources, the results are presented as thematic findings derived from published literature, government reports,

institutional records, and industry documents rather than from primary survey responses.

3.7 PCMC Digital Context

The context of this study is relevant, taking into account the local situation of PCMC. As per PCMC's own documentation on the Smart City, Digital Governance is one of the important elements, which includes initiatives like the Smart City SCADA, Vehicle Tracking, e-Payments, Building Permit through AutoDCR, 40 application modules, GIS Database, Citizen App, Dashboards and Command and Control ambitions. Also, Digital services for citizens, such as property tax, grievance registration, water tax, building permission, dashboards, PCMC Smart Sarathi, etc., are also mentioned on PCMC's website. This validates the women architect entrepreneurs' presence in an urban governance environment that is in a digital transformation process in PCMC. The results of this study indicate that this digital ecosystem is not making the same inroads into the small firms of women architects

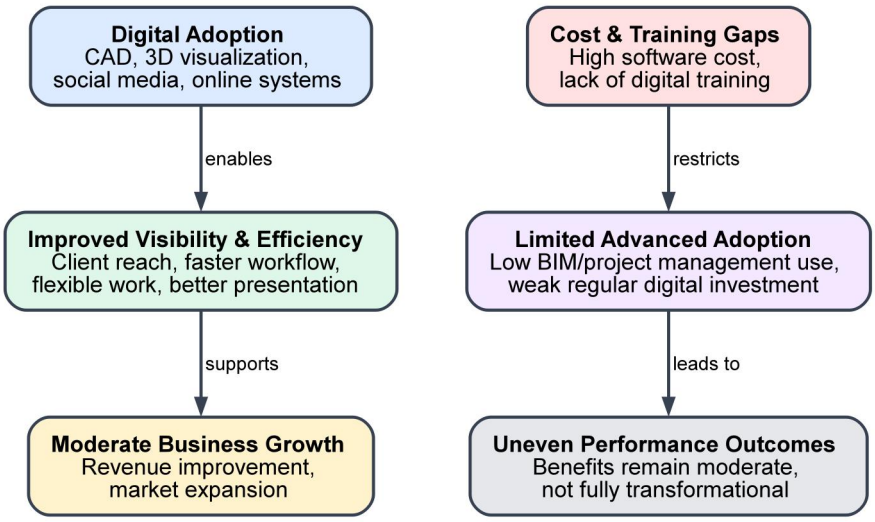

Figure 3: Conceptual result model showing

The results show in general that the digitisation has been embraced at a high level, yet with varying degrees of translation into business performance. Highest scores are for operation efficiency, design visualisation, remote working and visibility. The challenge areas include BIM adoption, digital investment on a regular basis, awareness of government-schemes and advanced business analytics.

4. Discussion

Based on the results of this study, it can be inferred that, today, digitisation has become a must for entrepreneurial architectural practice in the PCMC region for women entrepreneurs. The results indicate that the architectural practice is closely linked to digital design, visualisation, communication and client involvement. This is a sign of the overall shift in the architecture, engineering and construction (AEC) sector, where digital technologies are reshaping how design works, how coordination takes place and how documentation is performed and are impacting the way that projects get delivered (Brozovsky et al., 2024; Manzoor et al., 2021). It's important to note that the use of digital tools is limited primarily to CAD and 3D visualisation, with BIM, project management software and simulation platforms having low adoption. This signifies that women are in functional digitisation, but not digital transformation. That is, women architect entrepreneurs are using digital tools for basic activities, but do not necessarily have a very high level of digital systems to support business strategy, project management or collaborative working processes. This seems to be in line with the idea that the level of digital readiness is a major factor in the digital competence of AEC companies (Chen et al., 2024). This also helps to justify the fact that BIM can't just be implemented as a piece of software, but rather as a strategy (Smith & Tardif, 2009).

Table 8: Business-Management Implications of Digitisation for Women Architect Entrepreneurs

Business-management area	Role of digitisation	Expected business outcome
Client relationship management	Online communication, virtual meetings, digital presentations	Better client engagement and trust

Marketing management	Social media, websites, digital portfolios	Improved visibility and client reach
Operations management	CAD, 3D tools, project management software	Faster workflow and better coordination
Financial management	Digital investment planning, cost tracking	Improved cost control
Strategic management	BIM adoption, digital upskilling, networking	Stronger competitiveness

The results also show that it is clear there are business opportunities in the digitisation. Digital platforms facilitate communication with clients, online visibility, presentation of design and flexibility with working remotely. These benefits are especially important for women architect entrepreneurs, as they can help reduce the need for in-person networking, enhance their professional reputation and reach more clients (Mittal & Bhandari, 2021). Likewise, the research conducted on women entrepreneurs has found that the Digitalisation can contribute to business expansion, improve market access and capability (Narang & Sharma, 2025).

But the results also show that the financial results of digitisation aren't consistently strong. This means that just digital adoption is not enough to ensure businesses can grow if they don't have a digital strategy, financial planning, marketing ability and professional networking. Previous studies on entrepreneurship highlight the fact that women entrepreneurs need to get access to knowledge, capital, networks and institutional supports to transform the opportunities into sustainable growth of enterprise (Gatewood et al., 2009). Hence, digitisation should be considered an enabler and not as a standalone solution to improve business performance.

The study also identifies a number of challenges that are hindering more advanced Dx. High software price, lack of training and quick development of technology are the greatest difficulties. This is due to financial, technical, and skill-related barriers that restrict the adoption of both commonly used design tools and advanced systems such as BIM and project management software. The introduction of a digital system typically leads to a reorganisation of processes in architectural firms, and these changes involve investments, learning of technical aspects and reorganisation of processes (Talamo & Bonanomi, 2019). It's the same story in architectural design. By digitalisation, the design process has become more accurate and efficient; there are training issues, software dependence and technological adaptation issues that need to be addressed (Zhang et al., 2018).

The gendered context of architectural entrepreneurship is also important. The representation gap is not the only gap in which women architects operate; there are also credibility barriers and access to opportunities, which are not equal. The findings show that digitisation can help to reduce the barriers to some extent, allowing for easier communication with clients, flexibility and visibility (Ahuja et al., 2009). Lack of financial access, mentoring, professional networks and policy will prevent it from significantly narrowing any structural inequalities. The previous studies focusing on the role of women in architecture and construction and entrepreneurship also confirm that women's entrepreneurial journey is shaped by the gender portrayal of the field, issues at the worksite, their mobility and their credibility (Ahmad & Abdullahi, 2025; Satpathy et al., 2019).

It is also important to note the lack of awareness and government/institutional support. These women entrepreneurs can be eligible for availing the MSME scheme, digital training programme, subsidy or entrepreneurship support, but if the information is not reaching the intended beneficiaries, then these may not be utilised. It is similar to the research findings of research conducted on the women entrepreneurs in India, which has identified the common problems faced by women entrepreneurs as Finance, Awareness, Training and Market access (Sharma & Gaur, 2020). So, the effectiveness of the policy is not only dependent on the availability of the schemes, but also on their accessibility, communication and implementation in the sectors. Overall, the study has indicated that digitisation is empowering and a challenge at a structural level. While it enhances the visibility, flexibility, efficiency and professional confidence on one hand, it also puts pressure on continuous investments and skill enhancement on the other. The additional support, like easy-to-use software, training, orientation, awareness about BIM, networking platforms and the linkage with institutional schemes, will be needed to achieve better results of women architect entrepreneurs in PCMC.

5. Conclusion

Based on the results of this study, it can be inferred that digitisation is an integral aspect of the architectural entrepreneurship of the women-led

architecture practices in the PCMC area. Digital tools have added value to the way architects are conveying their projects, communicating with clients, being visible and improving their workflow and flexibility of managing architectural services. When women architect entrepreneurs are utilising the digital change, they are adopting CAD, 3D visualisation, digital communication and online marketing platforms. But the impact of digitisation is not across the board or revolutionary. There are other tools like BIM, simulation software and project management platforms that are not fully utilized and digitalisation can give some growth and visibility to businesses. Higher software costs, limited training, fast technology change and lack of structured institutional support are factors limiting the possibility for further integration of digital technologies. The findings indicate that digitisation can be a chance and a challenge. Not only does it give women entrepreneur's greater access to the market and provide them with flexible working practices, but it also puts a strain on constant investments, learning and adaptation to technologies. But even so, there is also a gap in understanding of various schemes and supports provided by the government, which also hampers the scope of benefits to the women-led architectural firms. Overall, it shows the need for the availability of affordable software, specific digital skills development programmes for certain groups, and awareness of institutional programmes and mentorship networks or professional support platforms. These are areas that can be strengthened that will help women architect entrepreneurs to come out of the digitised zone and move towards growing their business and enabling competitive digital transformation.

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