

# Enhancing E-commerce Web Applications through Search Engine Optimization: A Review and Framework

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**Abstract:** As more countries embrace the digital economy and the number of internet users worldwide grows daily, e-commerce has become the backbone of many businesses communicating online with their customers. This increase has led to millions of online shops competing for attention in an already saturated digital marketplace, thereby making the attainment of online visibility in search engines both a problem and a necessity. This paper aims to resolve the key problem of enhancing the visibility and performance of e-commerce web applications in search engine results. This approach involves analyzing the existing e-commerce SEO techniques, directly focusing on e-commerce-related challenges, and providing a well-tailored framework as a solution. The key takeaways of this paper are. First, it features an in-depth evaluation of SEO strategies that work specifically well on e-commerce web applications, emphasizing technical SEO, on-page SEO, and off-page SEO. Second, it provides practical recommendations on implementing these tactics without violating search engine guidelines to perform better in organic traffic and sales conversions. This paper finally compiles insights from various research studies into a single framework for implementing SEO strategies in e-commerce web applications to help organizations navigate efficiently through the competitive environment of the online marketplace. This review is an excellent resource for e-commerce businesses, digital marketers and web developers looking to improve their online presence and long-term sustainability via effective SEO practices.

**Keywords:** Search Engine Optimization, E-commerce, Web Applications, SEO, Digital Marketing, Online Shops, Local SEO

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## 1. INTRODUCTION

Businesses are reshaping how they operate due to the fast growth of e-commerce, and online visibility has become a key contributor to their success. However, most e-commerce websites fail to rank in the top listings of search engine results, which in turn affects their ability to lure potential customers. This is mainly caused by the multi-dimensionality of search engine algorithms and competition in an already congested online marketplace (Jain & Bishwkarma, 2021; Cui & Hu, 2011). Thus, as a growing number of people seek information and make purchasing decisions online, a search engine optimization (SEO) strategy that aims to increase a company's online visibility by improving rankings in search engines has become a necessary instrument for many (Wu, 2011; Wang, 2016).

There is a great need for SEO in e-commerce businesses. It helps increase the traffic to the website and enhances the overall user experience, which leads to increased sales conversions (Simeramisna, 2023; Wang, 2016). Relying solely on paid advertising for online visibility often fails to achieve the required success as they do not address the cardinal issues that affect search engine rankings, such as site structures, keyword and content optimization (Cai, 2020; Cui & Hu, 2011). Hence, knowing and executing the best e-commerce SEO practices is imperative for e-commerce enterprises to prosper in the digital marketplace (Jain & Bishwkarma, 2021; Wu, 2011).

Nevertheless, implementing SEO for e-commerce sites is a painstaking task. Many existing solutions encounter limitations by focusing on generic SEO techniques that do not consider the peculiar nature of e-commerce websites, including dynamic content and complex website architectures (Wu, 2011; Song, 2006). Moreover, search engines continually update their algorithms, resulting in constant changes to the underlying principles of SEO, which is hard for most businesses to track

(Giomelakis & Veglis, 2006). This paper seeks to solve these challenges by examining and evaluating the existing works on SEO techniques for e-commerce web applications and identifying their strengths and weaknesses.

Our approach is an in-depth analysis of major SEO components such as keyword optimization, link building and website architecture enhancements (Cai, 2020; Song, 2006). This may also include advanced techniques such as machine learning algorithms to tailor search results to user preferences and improve their experience (Simeramisna, 2023). These strategies require continuous efforts and expertise to execute correctly, but they can improve search engine results drastically. Moreover, the dynamic nature of e-commerce web applications hinders achieving consistent SEO results (Wu, 2011; Boriskina, 2006).

This study aims to bring all the practices of optimizing e-commerce web applications via SEO into a well-tailored framework. Moreover, it is through identifying the particular pain points that e-commerce platforms have to deal with and providing a targeted solution framework that we achieve our goal of helping businesses with the tools to improve their presence and performance online. Using this review, we aim to add to the existing conversation concerning best practices in E-commerce SEO and the impact it has on e-commerce businesses (Jain & Bishwkarma, 2021; Cui & Hu, 2011; Wang, 2016).

## 2. RELATED WORK

This literature review combines and analyses previous studies on search engine optimization (SEO) techniques relevant to e-commerce Web applications. These strategies address product visibility, user engagement, and conversion rates. Implementing robust SEO strategies is one of the most effective ways to boost e-commerce performance. Hasanat et al.

emphasize that adding an SEO component to social media marketing can increase sales for retail businesses (Hasanat et al., 2020). Integrating social media helps maximize brand awareness and increase brand visibility across multiple platforms, which is very important in this competitive market. Furthermore, Ziakis et al. highlight other elements that enhance search rankings, such as website structure, content relevance, and user experience (Ziakis et al., 2019). These building blocks ensure that e-commerce sites are indexed and ranked well.

SEO for e-commerce content is essential. As Purnomo highlights, combining digital marketing strategies, including SEO and content marketing, is paramount for increasing sales conversion rates on e-commerce platforms (Purnomo, 2023). Unique product descriptions, blog posts, and guides can increase user engagement and search engine rankings. Furthermore, featuring customer reviews and testimonials on e-commerce platforms improves SEO and consumer confidence by providing relevant content that search engines prefer (Purnomo, 2023).

Mobile responsiveness, site speed, and structured data are important technical SEO components necessary for the success of e-commerce. Ridwan explains the optimization of product placement using algorithms to improve user experience, which is a significant element in retaining customers and reducing bounce rates (Ridwan, 2024). These days, many online shopping activities occur on mobile devices, so it is wise to ensure that e-commerce websites are mobile-friendly. These findings are consistent with those of Wang and Putit, who argue that marketers must better understand how people shop online (Wang & Putit, 2023).

Improving the user experience with SEO is also an important tactic. According to Akbar and Ariesta, a consumer-centric approach where effective SEO practices are adopted can drive long-term profitable relationships with consumers (Akbar & Ariesta, 2021). This approach includes optimizing navigation, enhancing site architecture, and loading product pages faster. Since user experience helps retain customers, it also leads to repeated purchases, making it one of the most important aspects of e-commerce for sustainability.

Finally, web analytics and KPIs (key performance indicators) are crucial in measuring the success of SEO strategies. Saura et al. amplify the significance of digital marketing metrics (DMM) analysis to adjust SEO and other marketing strategies (Saura et al., 2017). Regular performance monitoring allows e-commerce companies to refine their strategies as consumer behaviours and preferences evolve.

Hence, based on this literature review, we note that applying multiple strategies to search engine optimization, such as optimizing content, improving technical aspects, enhancing user experience, and closely measuring performance, is crucial for the success of any e-commerce web application. Through these tactics, e-commerce businesses can improve their visibility, engage users efficiently, and ultimately increase sales growth.

### 3. SEO CHALLENGES FACING E-COMMERCE WEB APPLICATIONS

Optimizing web applications for e-commerce through Search Engine Optimization (SEO) comes with unique challenges that can significantly influence their visibility and success. Duplicate content can occur for several reasons, such as product variations and multiple URL paths to the same product page. This duplication may confuse search engines and

negatively affect product ranking and visibility (Ziakis et al., 2019). Dynamic content, which arises as a result of users' interactions with e-commerce sites or changes made to product inventories, can compound the indexing procedures for search engines, making it difficult to measure the relevance of web pages (Ziakis et al., 2019; Vyas & Gupta, 2017). Another issue is having the same title on different product pages. E-commerce platforms often contain several products that might share the same duplicate titles or similar descriptions, which can weaken their chances of good ranking in search engines. Complicating this issue further is the lack of product reviews, which affects the consumers and denies search engines the rich content they prefer and love (Ziakis et al., 2019). The lack of unique and engaging content can reduce the SEO performance of a page, as search engines attach more value to pages that provide relevant information to users (Ziakis et al., 2019; Hoque et al., 2018). E-commerce sites also struggle with redirects because when page redirects are faulty, they can cause search engines to lose track of which page they should display because of being confused about the primary version of a page, resulting in the loss of link equity (Ziakis et al., 2019). This problem usually appears when products are discontinued or replaced, and correctly handling the redirects is key to maintaining the SEO strength of the site. In addition, non-optimized product pages potentially missing key SEO elements like meta descriptions, ALT tags for images, and structured data can also adversely affect the rank of an e-commerce web application in search results (Ziakis et al., 2019; Vyas & Gupta, 2017).

To summarise, e-commerce web applications must overcome different SEO hurdles: duplicate and dynamic content, repeated titles, lack of product reviews, and improper redirection. Combating these issues is crucial to increasing visibility and revenue in a saturated online landscape.

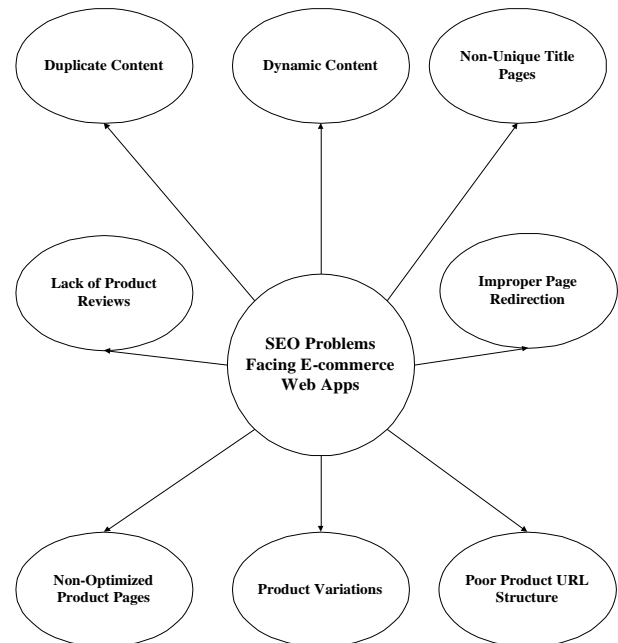


Figure 1. SEO Challenges Facing E-Commerce Web Apps

### 4. FRAMEWORK FOR ENHANCING E-COMMERCE WEB APPLICATIONS

## THROUGH SEARCH ENGINE OPTIMIZATION (SEO)

This framework combines SEO strategies that address the unique optimization challenges facing e-commerce web applications. It is designed to be a practical step-by-step resource for web developers, business owners, and digital marketers, focusing on actionable techniques that improve search engine visibility, user engagement, and sales performance.

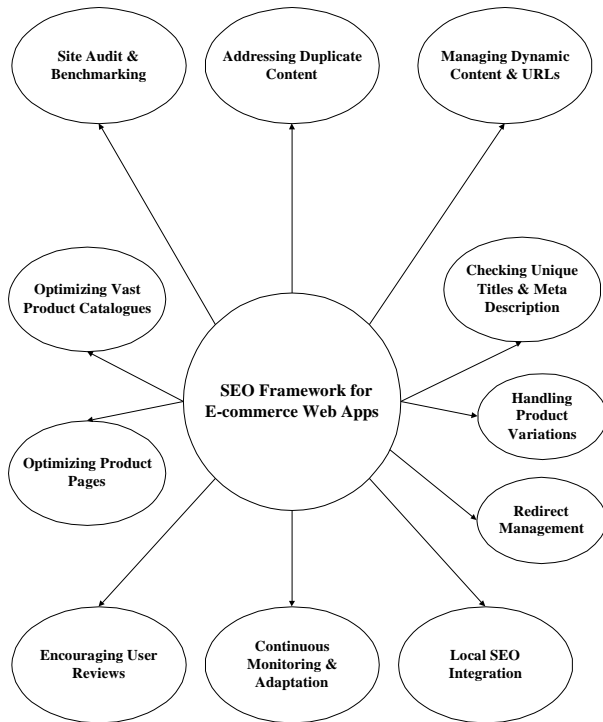


Figure 2. SEO Framework for E-commerce Web Applications

### 4.1 SEO Audit and Benchmarking

The effort required here involves conducting a comprehensive SEO audit on the e-commerce site and examining the competitors' e-commerce sites to reveal their SEO strategies.

#### 4.1.1 SEO Audit

Conduct a site audit on existing e-commerce web applications using SEO tools like Ahrefs, SEMrush, Google Analytics, and Ubersuggest to examine the On-page SEO, Off-page SEO and technical SEO factors (Basuki, 2023). They will provide insights into keyword rankings, traffic patterns, and site health (Poturak et al., 2022) (Aryani et al., 2023).

Discover areas like page load time, mobile responsiveness, and current keyword rankings that require enhancement.

#### 4.1.2 Benchmarking Against Competitors

Analyze competitors' e-commerce websites to discover the strengths and weaknesses of their SEO strategies. This action can provide relevant information that will help understand positioning in the marketplace and identify areas for improvement (Purnomo, 2023).

Use tools like SimilarWeb or SpyFu to examine competitors' traffic sources and keyword strategies.

### 4.2 Addressing Duplicate Content

Solving this problem will need implementing Canonical Tags, creating Unique Product Descriptions and using the Noindex for Duplicate pages.

#### 4.2.1 Implement Canonical Tags

Use canonical tags on product pages to identify the selected version of a page to search engines. This action can prevent the problem of duplicate content caused by similar product descriptions or variations (Ausat & Peirisal, 2021).

#### 4.2.2 Create Unique Product Descriptions

Create unique and high-quality item descriptions for each product. Avoid using manufacturers' descriptions word for word because this can result in duplicate content across many websites (Gali et al., 2020). Use storytelling strategies to engage customers and differentiate products.

#### 4.2.3 Use Noindex for Duplicate Pages

Use the "noindex" HTML tag to prevent search engines from indexing pages that are necessary but contain duplicate content (Samad, 2023).

### 4.3 Managing Dynamic Content and URLs

Optimizing the URL structure and implementing Data Markup are necessary here.

#### 4.3.1 Static URL Structure

Implement URL rewriting to create static, keyword-rich URLs that search engines can crawl more easily. Avoid complex query strings that confuse search engines (Akbar & Ariesta, 2021).

#### 4.3.2 Structured Data

Implement structured data (schema markup), which can assist the search engine in crawling dynamic pages more efficiently, resulting in rich snippets in search results (Haryanto & Chang, 2018).

Implement structured data in the JSON-LD format for better search engine readability.

### 4.4 Optimizing Vast Product Catalogues

There is a huge need to organize products into categories and use Paginations and Sort and Filter options to address this challenge.

#### 4.4.1 Organize Products into Categories

Create a well-defined category and subcategory structure to improve navigation and help search engines index the site more effectively (Subagja, 2023)—Breadcrumb Usage for Improving User Experience and SEO.

#### 4.4.2 Pagination and Infinite Navigation

Use pagination for large product lists to ensure the indexing of all products without overwhelming search engines. Use the HTML codes rel="next" and rel="prev" tags to indicate relationships between paginated pages (Tan & Ludwig, 2016).

#### 4.4.3 Filter and Sort Options

Implement filter and sort options that do not create new URLs for each variation. Instead, use AJAX to dynamically update the content without changing the URL structure (Sarsah et al., 2020).

## 4.5 Creating Unique Titles and Meta Descriptions

To achieve this effort, use Dynamic Title Generation, Consistent Branding, and optimized Meta Descriptions for each product.

### 4.5.1 Dynamic Title Generation

Use dynamic title generation techniques to create unique titles for each product page based on product attributes. Ensure that titles are descriptive and include relevant keywords (Huang & Chiu, 2017).

### 4.5.2 Meta Description Optimization

Write engaging and unique meta descriptions for each product page. Include a call-to-action (CTA) and appropriate keywords to increase click-through rates (CTR) from the search results (Muliawan, 2023).

### 4.5.3 Consistent Branding

Use brand names in titles and descriptions to improve brand recognition and build trust in users' minds (Ziakis et al., 2019).

## 4.6 Optimizing Product Pages

This solution will require implementing High-Quality Images and ALT text, User Reviews, Ratings and Call-To-Actions.

### 4.6.1 High-Quality Images and Alt Text

Use quality images for products and optimize ALT text with relevant keywords to increase visibility within image searches (Desai, 2016). Improve user experience by applying zoom features and 360-degree views.

### 4.6.2 User Reviews and Ratings

Request customers to write reviews and ratings on the product pages. This move promotes credibility and unique content generation, a positive for SEO (Erdmann & Casado, 2021). Now, implement a product review system where users can filter reviews by rating, date of posting, and reading time.

### 4.6.3 Clear Call-to-Actions (CTAs)

Ensure product pages include CTAs and that these CTAs encourage users to purchase (Sheffield, 2020).

## 4.7 Handling Product Variations

Implementing Consolidated Product Pages, Structured Data, and Unique URLs for Product Variants is a good way to handle this issue.

### 4.7.1 Consolidated Product Pages

Use a single product page for variations (e.g., size, colour) and implement a dropdown or selection tool for users to choose their preferred option. This step helps to avoid duplicate pages for each variation (Chen & Sénéchal, 2023).

### 4.7.2 Structured Data for Product Variants

Implement structured data for product variants to ensure search engines distinguish between product variations (Yapar et al., 2015).

### 4.7.3 Unique URLs for Product Variants (if necessary)

If unique URLs are required for certain variants, ensure that canonical tags point back to the main product page (Setiawan et al., 2020).

## 4.8 Redirect Management

In order to manage redirects, there is a need to apply 301 Redirects, Regular Redirect Audit, and avoid Redirect Chains.

### 4.8.1 301 Redirects

Apply 301 redirects, which are essential for preserving link equity and ensuring users land on the correct content without facing errors for internal links that have permanently changed (Mathur et al., 2018).

### 4.8.2 Regular Redirect Audits

Conduct frequent audits of redirects to discover and remove unnecessary or erroneous redirects that can slow site performance (Purnomo, 2023).

### 4.8.3 Avoid Redirect Chains

Limit redirect chains to prevent link equity dilution and negatively impact page load speed (Zhang et al., 2019).

## 4.9 Encouraging User Reviews

Automated Review Requests, Prominent Review Displays, and Incentivizing Reviews are necessary parts of this solution.

### 4.9.1 Automated Review Requests

Use automated emails after a purchase to remind consumers to leave reviews. This action can result in a much higher number of reviews on product pages (Basuki, 2023).

### 4.9.2 Display Reviews Prominently

Ensure customer reviews and ratings appear prominently on product pages to build user trust and engagement (Giomelakis et al., 2019).

### 4.9.3 Incentivize Reviews

Try providing incentives for customers who write reviews, such as discounts on their next order or entry into a raffle (Cheung et al., 2016).

## 4.10 Continuous Monitoring and Adaptation

Monitoring KPIs, staying updated with SEO Trends and carrying out regular Content Updates will address this issue adequately.

### 4.10.1 Monitor Key Performance Indicators (KPIs)

Use analytics tools to measure metrics like organic traffic, conversion rates, and bounces. This data will be applied to orphan pages in an iterative approach.

### 4.10.2 Stay Updated with SEO Trends

Stay updated with the recent trends and algorithm changes in SEO to prevent optimization strategies from becoming outdated and misleading against search engine rules.

#### 4.10.3 Regular Content Updates

Update content regularly to reflect changes in inventory, promotions, or trends, ensuring that the site remains relevant and fresh.

### 4.11 Integrating Local SEO into the E-commerce SEO Framework

Local SEO is a concept that makes it easy for web pages to appear in local search results. Optimizing for local search includes targeting local keywords, managing online listings, and ensuring the businesses appear in local directories and maps. For e-commerce businesses, local SEO can attract customers searching for products or services nearby, resulting in more foot traffic to physical stores and online sales.

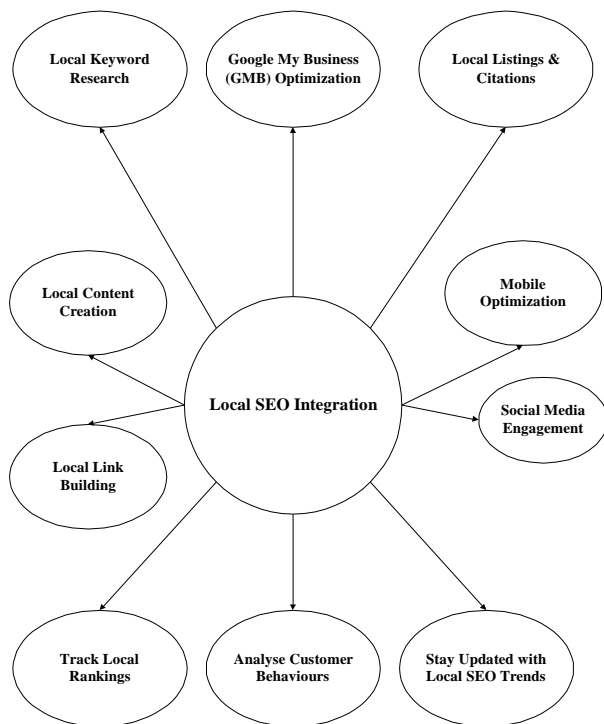


Figure 3. Integrating Local SEO into E-commerce SEO Framework

#### 4.11.1 Local Keyword Research

The steps required here include Identifying Local Keywords and using Long-Tail Keywords.

##### 4.11.1.1 Identify Local Keywords

Use keyword research to find the words intended for customers to search for products within an area. SEO tools such as Google Keyword Planner identify local search keywords (Ausat & Peirisal, 2021).

##### 4.11.1.2 Long-Tail Keywords

Target long-tail keywords with geography modifiers (e.g. "buy shoes in City Name") to serve more precise search queries (Ausat & Peirisal, 2021).

#### 4.11.2 Google My Business (GMB) Optimization

In achieving the optimization of Google My Business, Claiming and Verifying the Business Listing, Profile Completion, and Regular Updates are necessary steps.

##### 4.11.2.1 Claim and Verify Business Listing

Enlisting a business on Google My Business (GMB) is a good first step. Claiming and verifying the listing makes it easier to see how the business appears in local search results and Google Maps (Amornkitvikai et al., 2022).

##### 4.11.2.2 Completion of Profile

Enter all pertinent information, including the business name, address, phone number, website, open hours, and categories. For better relevancy, incorporate local keywords in the business description (Amornkitvikai et al., 2022).

##### 4.11.2.3 Regular Updates

Update the changes in Google My Business (GMB) hours, services, or promotions. Regular updates tell Google the business is alive and engaged (Keegan, 2019).

#### 4.11.3 Local Listings and Citations

To accomplish this step, there is a need to Ensure Consistency Across Directories and Build Local Citations.

##### 4.11.3.1 Ensure Consistency Across Directories

One way to make it quicker for people to locate a business is to have it listed on local directories like Yelp, Yellow Pages, and industry-specific sites with the opportunity of reference. Be sure to keep the business name, address, and phone number (NAP) the same on every platform (Gregory et al., 2019).

##### 4.11.3.2 Build Local Citations

Get the businesses mentioned on local websites and blogs, which can improve their local search ranking. Partnerships, sponsorships, or community involvement can achieve all these efforts (Xie et al., 2022).

#### 4.11.4 Local Content Creation

This task requires the creation of Location-Specific Content, and use of Local Language and Culture.

##### 4.11.4.1 Create Location-Specific Content

Create localized content tailored to the local market. Such content might be blog posts on local happenings, guides to local points of interest or profiles on local purveyors (Zeng et al., 2019).

##### 4.12.4.2 Use Local Language and Culture

Localize the site content—modify it to best suit the local culture and language (Caro, 2024).

#### 4.11.5 Mobile Optimization

Implementing Responsive Design and Local Landing Pages will accomplish this strategy.

##### 4.11.5.1 Responsive Design

Ensure that the e-commerce site is mobile-friendly. Many local searches are made on mobile devices. A responsive design gives users a better experience and can also rank in local searches (Ziakis et al., 2019).

#### 4.11.5.2 Local Landing Pages

For a business with multiple locations, create a dedicated landing page for each location. Each page should contain relevant content and be optimized for local keywords.

#### 4.11.6 Local Link Building

Engagement with Local Business and Local Media Coverage are the required efforts here.

##### 4.11.6.1 Engage with Local Businesses

Establish relationships with other businesses and organizations within the same vicinity to open the opportunity for backlinks. This effort can be through sponsorships, collaborations or participation in local community events (Erdmann & Casado, 2021).

##### 4.11.6.2 Local Media Coverage

Contact local media and bloggers to feature the business's products. Media coverage can generate essential backlinks for the local SEO strategy and improve local visibility (Pang, 2022).

#### 4.11.7 Social Media Engagement

It is a necessity to Utilize Local Hashtags and Promote Local Events to fulfil this need.

##### 4.11.7.1 Utilize Local Hashtags

Use hashtags on social media platforms to reach a wider audience within the business's vicinity. Participating in local events and trends can boost business visibility (Grant, 2024).

##### 4.11.7.2 Promote Local Events

When a business participates in a local event, it should promote it on the company's social media platforms and encourage people to share their experiences (Subagja, 2023).

#### 4.11.8 Track Local Rankings

Use Local SEO Tools to achieve this requirement.

##### 4.11.8.1 Use Local SEO Tools

Use tools like Moz Local or BrightLocal to monitor local search rankings and online visibility. Regular monitoring can reveal areas for improvement (Rahman, 2018).

#### 4.11.9 Analyze Customer Behaviour

Google Analytics and Conversion Tracking are necessary to complete this action.

##### 4.11.9.1 Google Analytics

Analyze traffic sources to the site and find out how visitors behave there through Google Analytics. Monitor how local customers interact with the site and adjust strategies appropriately (Ibrahim et al., 2018).

##### 4.11.9.2 Conversion Tracking

Use conversion tracking to measure the sales and leads generated by the current Local SEO activities (Song, 2023).

#### 4.11.10 Stay Updated with Local SEO Trends

To achieve this requirement, Follow Local SEO Blogs.

##### 4.11.10.1 Follow Local SEO Blogs

Follow relevant SEO blogs and forums to stay updated with market trends. This will enable the fine-tuning of the tactics according to recent trends and algorithm changes (Amornkitvikai et al., 2021).

## 5. FUTURE DIRECTIONS

The future of improving e-commerce web applications through Search Engine Optimization depends mainly on adopting technological advancements, adapting to changing consumer behaviours and implementing innovative strategies. By concentrating on possible areas of integrating E-commerce SEO with Artificial Intelligence and Machine Learning, Voice Search Optimization, Enhanced Local SEO, Big Data Utilization, Content Marketing, Security and Trustworthiness, New E-commerce Models, Continuous Learning and Adaptations, businesses will better navigate the ever-changing and highly competitive e-commerce landscape. These future directions are essential for improving search engine visibility and customer loyalty, ensuring continued growth and sustainability.

## 6. CONCLUSION

SEO is critical for e-commerce web applications, impacting visibility, user interaction, and sales results. The developed SEO framework will allow online business owners, web developers, and marketers to elevate and fortify their positions in a highly competitive market. Bringing in artificial intelligence innovations in this area is crucial to keep up with changing trends in online shopping.

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