

## Review Article

# **.NET tools for software development: tool selection, key benefits of .NET web applications**

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### **ABSTRACT**

**Aims:** this report analysis the top 5 .NET tools that can be used to develop website and software.

**Study design:** we have shortlisted the 5 .NET tools that can be used to design and implement website and software.

**Methodology:** According to Microsoft, .NET is a software-based approach for integrating information, users, technologies, and devices, and it encompasses everything that an organization requires to build and deploy an integrated data architecture: servers used to host services; development tools; and apps that utilize them. We have selected Web essential for Visual studio, Resharper, Ncrunch, NuGet and Elmah tools.

**Results:** The exposed qualities connect to modern emerging techniques such as components, allocation, software and services, and online redirection. As a result of the available options, .NET is recognized as one of the most extensively used software development platforms. The framework .NET's of devices and technologies as well as their optimal usage in practice, need knowledge with its tool set.

**Conclusion:** The NET-framework offers a variety of software types, with a focus on producing apps for Windows, mobile devices, and the Internet. Windows applications can be terminal (text-based) or graphical, including drivers, libraries, and services. Applications for mobile devices are created for smartphones and tablets. ASP.NET web services and web applications written for the Internet.

*Keywords: .Net framework, .NET tools, Resharper, Ncrunch, NuGet, Elmah*

### **1. INTRODUCTION**

Today's applications often necessitate the combination of XML and relational data together within object-oriented programming language (OOPL). The connection between both the underlying data and the OOPL has traditionally been managed by offering a call-level interface with a particular API for application programming (API) that developer utilizes to facilitate the conversations between both the OOPL and the data using function calls and query string representations. Aside from call-level interfaces, there are numerous object-relational mapping (ORM) techniques, such as the Java Persistence API, that offer a layer of abstraction to combine the OOPL and the relational database [1].

The.NET framework's success has resulted in a significant increase in the amount of third-party solutions. In the.NET environment, there is a treasure mine of free tools, with most developers currently utilizing well-known tools like the Notepad++ editor and open-source code exchange sites like SourceForge.net. These technologies assist Dotnet developers to construct user-friendly apps while increasing productivity. However, choosing the correct tool is more straightforward than it appears. Often, developers must conduct extensive research

to determine what would perform effectively for business, which is a time-consuming and tiresome procedure [2].

Microsoft.NET is a software development framework and ecosystem that enables the quick development of desktop and web applications. It is a well-known free platform that is currently used for a variety of applications because it provides the development environment for the most of software development lifecycle. .NET is best suited for organizations that require a wide range of capabilities, such as web applications, desktop applications, and cloud support infrastructure [2].

## **1.1 HISTORY OF .NET FRAMEWORK**

In the late 1990s, Microsoft began creating the .NET platform. The objective was to create a platform on programming language, or software that can operate in a runtime. This was necessary in order to increase technical expertise and liberate engineers from having to deal with security processes, active memory usage, and other low-level duties that C/C++ programmers would be required to deal with [3].

### **1.1.1 The .NET 5 and .NET 6 era**

The business confirmed the crucial release that will tie the ecosystem together in May 2019: the .NET 5 development platform, which will encompass all .NET elements. The .NET 5 integrated development platform was eventually deployed in November 2020. The successors to .NET Core 3.1 and .NET Framework 4.8, .NET 5, provides order to the .NET world by offering a wide range of options for developing programs for Linux, Windows, macOS, iOS, Android, watchOS, tvOS, and WebAssembly. The platform includes new APIs, runtime capabilities, and language features. .NET 5 also includes ASP.NET Core, Entity Framework Core, Xamarin, WPF, ML.NET, and WinForms [4].

### **1.1.2 .NET Core**

.NET Core was launched in 2016. It is a .NET Framework re-build that is cross-platform. Engineers may now use the program on Linux and macOS, rather than only Windows, to create apps that aren't necessarily confined to a Windows family. Because certain cloud services, including such Digital Ocean, are Linux-based, the new system wants to dominate the market. In addition to being Core cross-platform, however its various versions may reside on the same device. Net Core includes ASP.NET Core and the Universal Windows Platform [3, 5].

## **1.2 BENEFITS OF .NET**

Following are the benefits of .Net framework [6]

### **Object oriented software development model**

- NET is an object-oriented programming framework (OOP).
- NET allows for the reuse of code and components, which saves time and, as a result, the cost of development.

### **Reliable and simple caching system**

- Caching is the technique of storing data in a different location in order for it to be rapidly accessible when needed.

- The .NET caching technology is both strong and easy to utilize. It's also meant to be extendable.
- The Object Cache class allows developers to create custom cache implements that may be used to boost the performance and flexibility of Windows client and server applications...

### **Visual Studio IDE**

- Visual Studio is a Microsoft integrated development environment (IDE) that is used to create, debug, and publish programs for all platforms, including Android and iOS.
- Visual Studio is linked to .NET and offers language-specific environment capabilities..

### **Automatic monitoring in ASP.NET**

- ASP.NET has automatic monitoring, and the Windows Web Server closely monitors the websites and applications that run on it.

## **1.3 DISADVANTAGE OF .NET**

.NET is recognized as one of the most powerful programming platforms accessible because of its massive infrastructure and long history of product development, but it is not without restrictions [6].

### **Limited Object-Relational Support**

- The Entity Framework supports data-oriented software application development in the .NET Framework and Core.
- Entity is an object-relational mapper (ORM) that joins object-oriented and relational (SQL) databases in the .NET Framework.
- According to some developers, Entity Framework is just too inflexible and cannot support all database designs..

### **Licensing cost**

- The majority of their dollars will be spent on the Visual Studio IDE and other collaboration and quality control services provided by Microsoft to make your life easier.
- Users can, however, still seek to become a Microsoft Partner in order to get a number of free subscriptions.
- While .NET Core may operate on Mac and Linux devices, it's indeed preferable to use Windows for .NET development, that requires a licensing price.
- If a customer has never used Microsoft products before and has to migrate from, example, the AWS cloud environment to Azure, the barrier will be significantly higher.

### **The gap between release and stability**

- Newly launched products lack adequate description, support, and stability, and are prone to abrupt changes.

## **2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY**

The first version of Microsoft Visual Studio.NET from 2003, also known as Visual Studio 7.0, was used to construct the Web application utilizing the ASP.NET technology using the development platform Microsoft Visual Studio.NET. A developer can use ASP.NET technologies to create a Web application in this environment. It also allows you to choose between two prominent programming languages, C# and VB, as well as another twenty. Visual Studio now supports adding class files from the Microsoft.NET framework when constructing an application [7].

Toolbox tabs are a nice feature in Visual Studio that allows us to deal with various components. There are various icons under these tabs that may be added to a Homepage by merely sliding these control to the site or pasting them into a code editor utilizing Visual Studio's integrated environment. Both of these processes will add a Toolbox item instance to the project folder. Visual Studio additionally has access to the Viewer or Databases Explorer (server administration console). This desktop window lets you to open a database server, log on to a server, and work with columns, tables, rows, Stored Procedures, and retrieve and change data from that server [8].

To manage the data logic, a combination of several sorts of programming languages, particularly the new.NET supported language C#, is employed, as well as a collection of distinct methodologies including server side technology, component based objects for data access and information manipulations. The Web application is also developed using integrated development tools such as Visual Studio and the SQL Server Management Studio [8].

Microsoft created ASP.NET, which is used to construct dynamic web pages. ASP.NET is a collection of underlying technologies that are built on the.NET Framework. The fundamental benefit of ASP.NET over the other systems in the same genre is that it is component and event driven, allowing it to offer a fully-fledged programming language rather than the simplistic scripting language used by some rival technologies [1]. Modern and simple OOP approaches are used to construct ASP.NET Web pages as well as other applications. Each ASP.NET page can have several objects and Web controllers. There are methods, properties, and events associated with these controls. The web server hosts each ASP.NET page. When a Web client requests a page, the server runs the code and transmits it to the browsers. The document is then delivered to the client in HTML, XHTML, or XML encoded form [7].

### **2.1 .NET PLATFORM ARCHITECTURE**

.NET is the foundation of Microsoft's future computer systems for both commercial and private users, and it enables the development of computer programs that are extremely powerful Web-based applications. The.NET Framework has a huge library from over 4000 classes arranged into namespaces that perform a number of useful tasks ranging from file output and input to string processing, XML parsing, and Windows Forms control. Each namespace includes program-usable types like as classes, structures, references, inheritance, and so on. They offer extremely useful functional building elements required for the creation of.NET applications [9].

Microsoft's namespaces all begin with System or Microsoft. System is an example of a namespace. Data made up of classes that reflect the ADO.NET architecture (ActiveX Data Object for .NET). Console programs, Windows applications with graphical interfaces, and Client / Server based Web apps are all examples of.NET applications. The Web application

may be enhanced with .NET supporting controls of those Web forms for a user-friendly display that works with the majority of browsers. Windows, Nokia, and certain HTC mobile devices use .NET apps. By utilizing .NET Directory interfaces and Lightweight Directory Access Protocol (LDAP), the .NET platform is increasingly popular for server-based operating systems and corporate Active Directories (AD) [10].

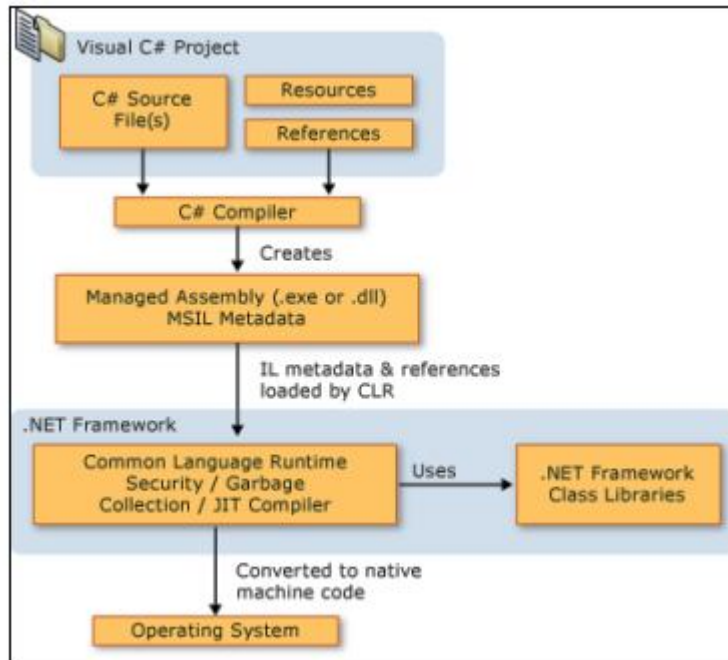


Fig. 1: .Net architecture [10]

The most essential aspect of the .NET framework design is its language "Interoperability" choices, which allow other languages, such as TCP / IP, HTTP, and other file formats, to be incorporated into a system. The IL (Intermediate Language) code created by the C # compiler complies to the CTS interface, and the code generated by C# can communicate with code generated by .NET version of Visual Basic, Visual C + +, or any of and over 20 other CTScompliant languages. A standalone executable can have numerous modules developed in various .NET languages such as C# and VB.Net [4]. Even if they are different languages, the modules can still refer to one other and interact as a single entity [10]

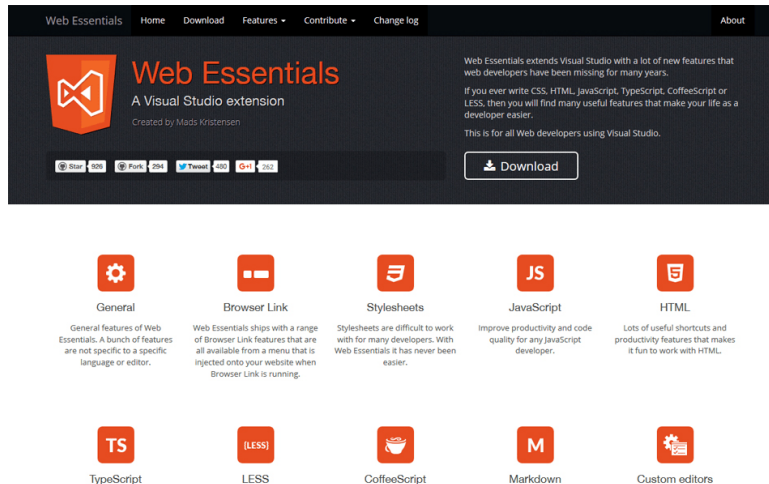
## 2.2 NET tools

The platform .NET supports a wide range of application types, which are enhanced by their dependent scale, application domain, and other characteristics. All of this necessitates the use of the right programming language in each and every scenario. The technologies listed below assist developers in creating effective websites and web services.

### 2.2.1 Web Essentials for Visual Studio

Microsoft's Visual Studio, that is unquestionably the most promising tools in use by developers for developing all types of programs, including mobile apps and websites, is at the top of our list. According to recent survey, almost 41 million active websites have used .NET. This plugin outperforms other Dotnet development frameworks in terms of productivity and is a must-have for writing and debugging code with ease.

Microsoft Visual Studio is an integrated development environment from Microsoft (IDE). It can be used to develop console and desktop application interface applications, in addition to Windows Forms software, web sites, web apps, and online services for all Microsoft Windows platforms, including Windows Mobile, Windows CE, the .NET Framework, the .NET Compact Framework, and Microsoft Silverlight [11].



**Fig. 2: Web essential homepage [11]**

### **2.2.2 ReSharper**

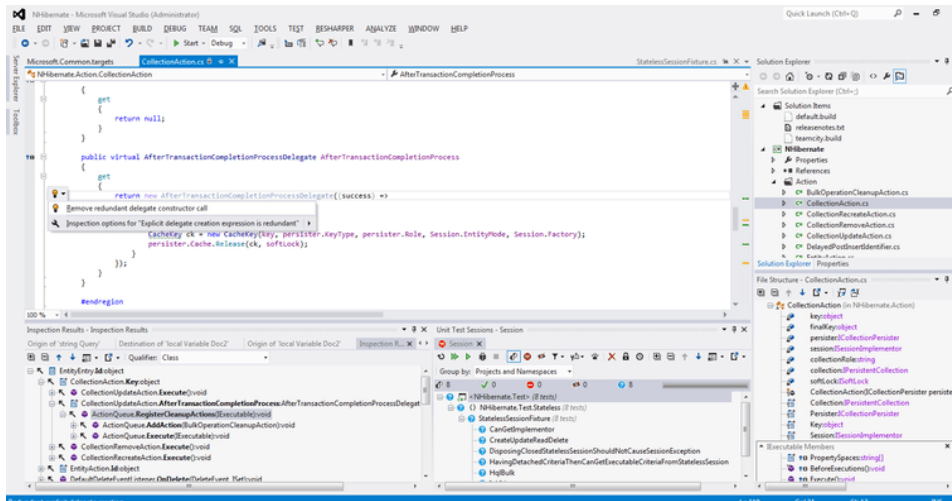
This is an obvious choice. This program not only assists developers in doing on-the-fly code reviews, but also provides several quick-fixes and automatic code reworking. JetBrains' ReSharper has over 60 refactoring and 450+ context operations. It's a useful tool for net developers who want to finish their projects fast, and it's also popular with programmers who are new to .NET.

ReSharper is the most popular productivity tool for .NET developers, and it works seamlessly with Visual Studio. It increases the productivity of thousands of .NET developers worldwide by delivering code inspections, automatic refactoring's, lightning-fast navigation, and coding guidance.

Anyone who wants to become more effective when building C# code must get their hands on this tool quickly as feasible. ReSharper Ultimate subscription includes • The package includes ReSharper (a code productivity tool) [12]

- dtTrace (a .NET Performance Profiler to optimize the code for performance)
- dottedMemory (a .NET Memory Profiler for avoiding memory leaks)
- dotCover (a unit test runner and code coverage tool for .NET) (a .NET decompiler and assembly browser, which is free by itself).

ReSharper's tools were commonly utilized by developers. ReSharper's expensive price, many of its capabilities require a significant number of system resource and slow down the IDE. The automatic refactorings recommended by ReSharper are mostly superficial, and the patterns created by refactoring necessitate additional consideration and human study [13].



**Fig. 3: ReSharper programming interface [13]**

### **2.2.3 Ncrunch**

Developers may use this tool to run tests while they write code. It's a testing tool which provides for the. Net developers must fulfill quality standards when developing code. Ncrunch extracts the necessary data from the tested code, allowing developers to enhance code quality at the same time.

Command-line arguments are used to control the tool. Simply run the program with no parameters supplied to see a complete list of potential choices.

It is critical to remember that each server that uses the tool should have loaded any SDKs and modules that are generally necessary to develop a solution and execute its tests. In terms of the software needs, the NCrunch desktop tools is subjected to the same limits as any collaborative build server. Depending on the type of the solution, users might or might not have to install Visual Basic or the Windows SDK.

The NCrunch configuration files contained inside codebase will be used by the tool to acquire solutions and project level configuration. If user have issues with the application on a CI server not functioning as well as the VS plugin, make sure these configuration files are verified in the sources control system.

The console tool makes full use of the NCrunch core engine. This means it can import projects into a solution, parse them, analyze them, create workspaces, build, instrument output assemblies, and run tests. It is, in essence, a frameless version of NCrunch. After a complete engine cycles, the consoles tool will write a set of reports to disk before self-terminating [14].



Fig. 4: NCrunch testing interface [14]

#### 2.2.4 NuGet

NuGet, a .NET package management, is an excellent addition to the .NET development toolkit. It enables developers to use third-party libraries to create and distribute their own solutions. NuGet contains over 98,000 packages, making it the biggest database of third-party .NET components. Developers may use this extension to explore an unfamiliar feed and manually construct packages.

A system for developers to produce, exchange, and consume valuable code is a vital feature for just any modern development platform. Such code is frequently packaged into "packages" that comprise compiled code (as DLLs) as well as other content required by the applications that use these packages.

NuGet is a Microsoft-supported framework for sharing code for .NET (including .NET Core), and it defines how .NET packages are created, hosted, and consumed, as well as offering resources for each of those operations.

A NuGet package is just a single ZIP file with the .nupkg extension that includes compiled code (DLLs), related files, and a complete manifest that provides data like as the product's version number. Programmer that have coding to contribute build packages, which are then compiled to a public or private site. Package consumers obtain such packages from suitable hosts, include them in existing applications, and then incorporate the functionality of such packages into their code. NuGet then handles the intermediate details.

Because NuGet provides private sites in addition to the public nuget.org host, users can use NuGet packages to share code that is exclusive to an organization or a work group. NuGet packages may also be used to simply bundle their unique code for use in just their own

apps. To recap, a NuGet package is a unit of code that may be transferred and does not need or suggest any particular way of sharing. [15].

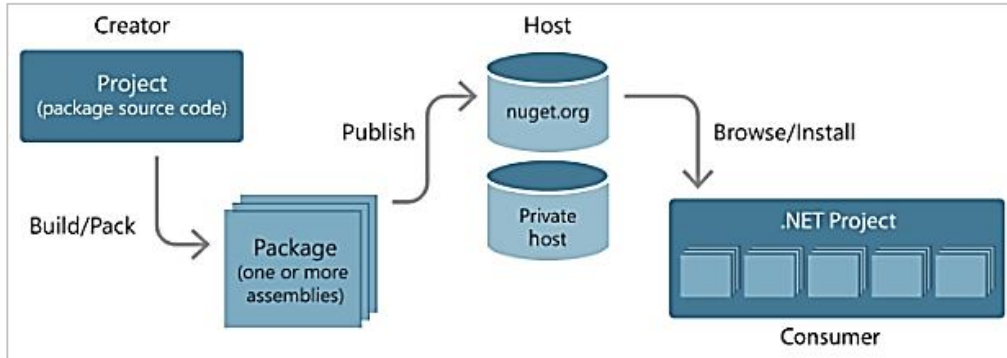


Fig. 5 NuGet process model [15]

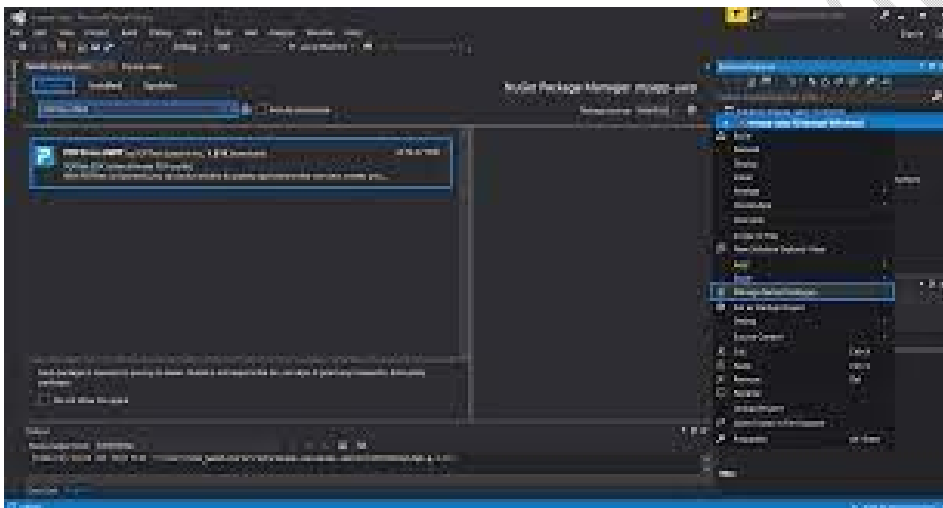


Fig.6 NuGet interface [15]

### 2.2.5 ELMAH

If users are developing a website, users will require Error Logging Modules And Handlers (ELMAH) to debug and log an error for ASP.NET. This error logging package, provided by Google, assists.NET developers in identifying holes in their code. The utility may be quickly added to an existing ASP.NET web application without requiring recompilation or re-deployment [16].

When users put ELMAH into a live web application and setup it properly, you receive the following features without altering a single line of code [17]:

- Almost all unhandled exceptions are logged.
- A web page that allows user to access the whole log of reported exceptions from anywhere.
- An online website that allows user to examine the entire details of every reported exceptions, including colored stack traces, from anywhere in the world.

- Even with customErrors mode enabled, user may often observe the initial yellow screen of death that ASP.NET issued for a specific error.
- E-mail notice of each mistake as it happens.
- An RSS feed of the log's most recent 15 mistakes.

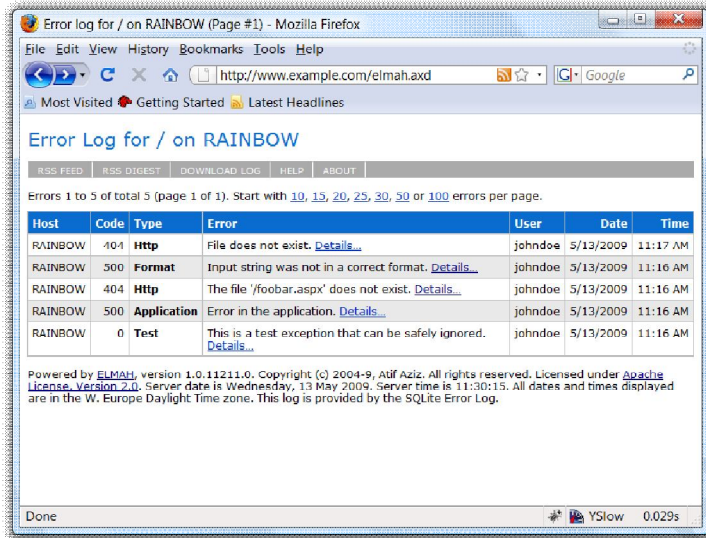


Fig.7 Elmah interface [16]

### 3. RESULTS AND DISCUSSION

Millions of software engineers rely on the .NET framework as an open-source technology. As a result, the number of third-party development tools has increased. To gain firsthand knowledge of the most important and useful development tools available.

#### 3.1 Web Essentials for visual studio

This Visual Studio plugin enhances the core VS functionality by including task shortcuts and improved Intellisense for CSS/HTML/JavaScript, among other things. This is a helpful option for Visual Studio web designers that might significantly increase productivity.

Custom editors, a Browser Link for easily seeing changes in browsers, TypeScript, Fewer, Markdown, and CoffeeScript support are all bundled in a single add-on.

#### 3.2 Resharper

Jetbrains has created a Visual Studio extension for this. Resharper gives the ability to examine code quality and rapidly detect and correct mistakes. It also has several shortcuts for rapid refactoring and navigation.

The following are some significant aspects of ReSharper that were employed in this study [1]:

- Over 1200 quick-fixes for C#, XAML, VB.NET, ASP.NET, TypeScript, JavaScript, and other languages are included in ReSharper.
- Context actions: ReSharper's contextual acts save developers time when making minor modifications to their code.
- Refactorings: ReSharper's collection of refactorings outnumbers Visual Studio's in terms of number, usefulness, and breadth of application.

### 3.3 Ncrunch

The console tool makes extensive use of the NCrunch core engine. This means it can import projects into a solution, parse them, analyze them, create workspaces, build, instrument output assemblies, and run tests. It is, in essence, a headless version of NCrunch. After one major engine cycles, the consoles tool will write a set of outputs to disk before self-terminating.

### 3.4 NuGet

NuGet is a .NET package management system that allows you to utilize third-party libraries while also developing and publishing your own. It is the huge database of third-party .NET components, with over 98 thousand packages already available.

NuGet automates the integration of third-party components into the Visual Studio projects during design time, and it offers a command-line interface for CI/CD automatic deployments. It is an essential need.

### 3.5 Elmah

When an issue happens on a production site, we utilize ELMAH to figure out what's going on in their code. This assists the developer in two ways: first, it records the error when it occurs, and second, it removes the user from the issue

The feature is useful when releasing a website into the open since you want to know if you missed anything in your code, but it's usually advisable to turn it off after a specific amount of people.

## 3.6 ANALYSIS OF TOOLS

Table 1. Analysis of tools [11, 13, 14, 15, 17]

Tools	Features	Weakness	Rating
Web Essentials for visual studio	<ul style="list-style-type: none"> <li>• image optimizer</li> <li>• bundler and minifier</li> <li>• web compiler</li> <li>• PHP tools</li> <li>• NPM Task Runner</li> <li>• WebPack Task Runner</li> <li>• Image sprites</li> <li>• Package installer</li> </ul>	<ul style="list-style-type: none"> <li>• Visual Studio Code contains a big number of extensions, which might make it challenging to identify the proper one for a certain task or slow down the software's speed.</li> </ul>	4.5/5

		<ul style="list-style-type: none"> <li>Some users might find the UI to be confusing or cluttered, particularly if a large number of extensions are installed.</li> </ul>	
Resharper	<ul style="list-style-type: none"> <li>Code quality analysis</li> <li>Code editing helper</li> <li>Code generation</li> <li>Eliminate error and code smells</li> <li>Safely change your code base</li> <li>Compliance to coding standards</li> </ul>	<ul style="list-style-type: none"> <li>Slows down Visual Studio after a time. Even for little jobs, it becomes quite sluggish.</li> </ul>	<b>4.5/5</b>
Ncrunch	<ul style="list-style-type: none"> <li>Visual Studio's automatic concurrent testing</li> <li>Test as you type</li> <li>Create for large, complicated projects.</li> <li>Distributed processing</li> <li>Highly customizable</li> </ul>	<ul style="list-style-type: none"> <li>Problem running large test</li> <li>Problem with code coverage</li> </ul>	
NuGet	<ul style="list-style-type: none"> <li>NuGet offers the core nuget.org repository with private hosting support, as well as the tools required for developers to create, publish, and consume packages.</li> <li>Most importantly, NuGet keeps track of the packages utilized in a project and allows you to recover and replace those items from that list.</li> </ul>	<ul style="list-style-type: none"> <li>Resuming incomplete downloads in the event of network disruptions</li> <li>Resuming incomplete downloads in the event of network disruptions</li> <li>Adding a user-friendly platform for adding and updating packages</li> <li>Package development feature in Visual Studio</li> </ul>	<b>4.4/5</b>
Elmah	<ul style="list-style-type: none"> <li>Error Logging</li> <li>Uptime Monitoring</li> <li>Deployment Tracking</li> <li>Heartbeats Monitoring</li> </ul>	<ul style="list-style-type: none"> <li>The ASP.NET MVC integration might be cumbersome.</li> <li>Some of the configuration pages are not very self-explanatory.</li> </ul>	<b>4.9/5</b>

This was our selection of the top five .NET development tools. Finally, the decision will be influenced mostly by the project that are attempting to finish. These technologies are used

by over seven million dot net developers to automate many manual operations in order to save time and eliminate human mistakes. The main line is that no matter the tools that use, be sure they allow users to complete a job without errors and on schedule.

#### 4. CONCLUSION

The option of. The .net tool changes widely depending on the activity or scenario. Using extra tools may liberate people from routine tasks and automate numerous operations, improving business performance and reducing mistakes. Some of them contain similarities as well as differences that might be quite useful in a certain context.

Many more tools are utilized in .Net application development projects. These are just a handful of the tools available. You may utilize the best .NET Development Tools available on the market today depending on the quality of the tools and the company requirements. The important thing to remember is that each tool you use should motivate users to accomplish the assignment on time.

#### COMPETING INTERESTS DISCLAIMER:

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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