

USE OF ENTERPRISE RESOURCE PLANNING IN INDUSTRIAL REVOLUTION 4.0

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ABSTRACT. In the era of the industrial revolution 4.0, industrial players are required to be able to keep abreast of the times, in order to remain competitive in that era. One way is to maintain and enhance existing competitive advantages by optimizing the company's value chain through the integration of all divisions. One way to achieve this goal is to use the tools of a planning information system called Enterprise Resource Planning (ERP) to support the optimization of the company's value chain activities from upstream to downstream, up to performance analysis of all relevant parts through data which are collected centrally to then be used as a basis for decision making. ERP is not without weaknesses, so it must be well considered what modules will be used when planning and the factors in choosing the right ERP solution.

Keywords: Resources, Competitive advantage, Integration, Planning, Industrial revolution 4.0

1. Introduction. The industrial revolution that caused massive changes in the world has been recorded 3 times, namely by the use of steam engines in industry, the use of assembly lines in the manufacturing process, and the use of computers and robots in industry. After these three eras, there is now a fourth type of revolution which is widely discussed and begun, namely the use of the Internet of Things (IoT) in the industry which includes many things, not only in the production process but also all related processes. In manufacturing, integration between various systems, in or across industries, has been progressing gradually and is accepted as one of the main features in the product life cycle. By looking at all the efforts and background above and reviewing from the academic side as well as from the practitioners' side of the industry, the question of research arises how the cross-operational role is in the fourth industrial revolution today. In order to provide scientific and reference based answers to answer this question, then this paper will be tried for presenting the main findings from the literature review on interoperability in the Industry 4.0 context, including the relationship between interoperability and findings that are expected to be able to further analyzed. The next part of this paper presents a systematic literature review, related to the relationship between enterprise resource planning as a concept and its transformational form during the industrial revolution 4.0 era, which was extracted from important concepts, based on the results obtained. In the end, it is expected that conclusions can be obtained that can be used to anticipate and

develop the use of enterprise resource planning in the era of the industrial revolution 4.0 in the future.

2. Literature Review. Enterprise Resource Planning (hereinafter abbreviated as ERP) is a concept for planning and managing resources owned by the company including funds (Financial), people (Human Capital), machines (Machineries), spare parts (Spare Parts), time (Time), material and capacities that have wide influence starting from the top management level to the operational level in a company so that it can be used optimally to produce added value for all stakeholders [1]. The concept has the main objective to integrate the overall activities of the company so that it can be more responsive to the various needs of the company such as: eliminating unnecessary processes (process elimination), simplifying complicated processes or long-winded (process simplification), the integration of processes stand-alone processes (process integration), and automation of manual processes (process automation). The term ERP was first coined in 1990 by Gartner, but it began in the 1960s. At that time, this concept was initially applied to inventory management and control in the manufacturing sector. Software engineers create programs to monitor inventory, reconcile balances, and report status. In the 1970s, this concept had developed into a Material Resource Planning (MRP) system for scheduling the production process [2]. In the 1980s, MRP grew to encompass more manufacturing processes, encouraging many to call it MRP-II or Manufacturing Resource Planning. By 1990, this system had evolved beyond the control of inventory and other operational processes to other back-office functions such as accounting and human resources, setting the stage for ERP as we know it. Currently, ERP has expanded to include Business Intelligence (BI) and also handle functions such as Sales Force Automation (SFA), marketing automation, and e-commerce.

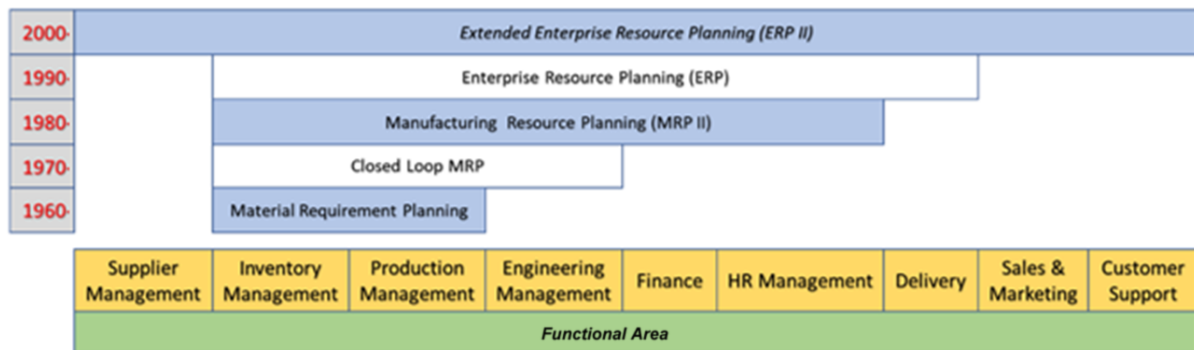


FIGURE 1. Chart of the evolution of ERP (<https://www.erp-information.com/history-of-erp.html>, reprocessed by the author)

From Figure 1 it can be concluded that ERP has undergone a significant evolution in the scope of functional areas that can be handled, from just material requirements planning into an integrated solution that covers many functional areas.

Before we talked about the concept of Idasar, there were a number of advantages of using the iERP system, among others:

1) ERP offers an integrated system that is fully required in the company, so that the process and the decision making process can be carried out in a more effective and efficient manner.

2) With iERP, it is possible to do global integration. Obstacles that were formerly different in terms of differences in imagery, differences in language, and differences in culture, can be bridged automatically, so that the data can be integrated.

3) ERP is not only a combination of data and resources, but also eliminates the need for updating and the possibility of updating many of the computers in the computer system,

which are separated so that the share of the company can improve the efficiency in the long term.

4) ERP allows management of operations management, and it is not just an imemonitor. With iERP, management is simply not able to answer the question “How is Ikita?” but even if we were able to answer the question “What do we have to do to make it better?”.

5) ERP can help facilitate management of supply with the ability to integrate the total that it has.

In addition to these advantages the ERP system also has the following disadvantages:

- 1) Limited customization of ERP software.
- 2) ERP systems are usually expensive.
- 3) Require re-engineering of business processes to adjust to industry standards that have been described by the ERP system which can cause loss of competitive advantage that the company has.

4) ERP is often seen as difficult to adapt to the workings and processes of certain ibisnis processes in some organizations.

5) The system can be too complex if compared to the needs of the customer.

6) Data in the iERP system is in one place, for example: customer, financial data. This can increase the risk of losing sensitive information, if it can break through the security system.

The manufacturing environment is internally passing through a technological and organizational transformation in the context of the Fourth Industrial Revolution [3].

3. Methodology. This study was conducted by searching the literature and sources of information on the Internet related to the problem discussed (in this case ERP) for later analysis. The main purpose of this literature search is to obtain relevant information and find out how far the link between the information is between one another, whether mutually supportive or not, among them:

- 1) Gather sources of information and existing literature, both from books, the Internet, pre-existing papers, own experiences, and other material related to this topic.
- 2) Read the sources that have been obtained.
- 3) Identify the information read whether it is relevant to what topics will be discussed.
- 4) Summarize the key points of each of the relevant literature.
- 5) Write down and rearrange the important points that have been obtained in a structured manner into a paper.

In the form of a chart, the stages of the analysis are explained in Figure 2.

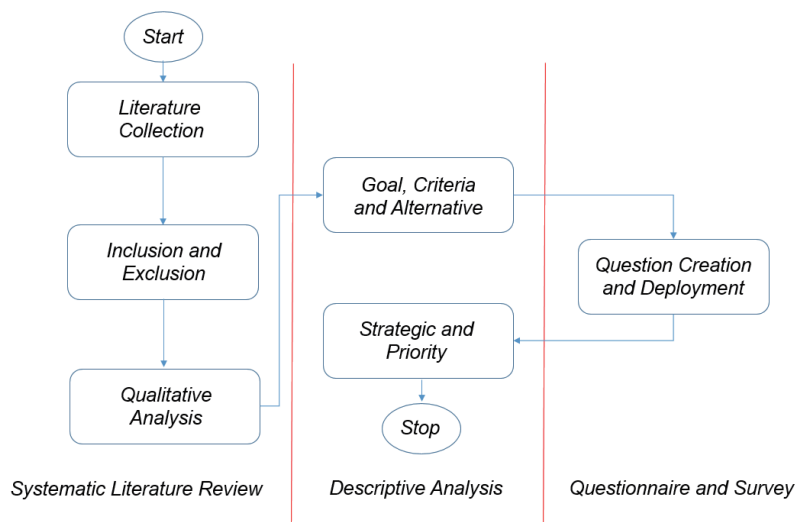


FIGURE 2. Research design

4. **Results and Discussion.** The basic concept of ERP can be described as Figure 3.

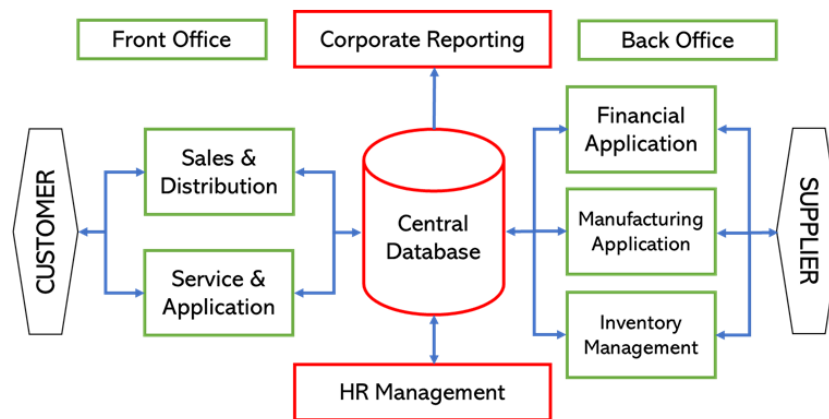


FIGURE 3. Chart of the basic concepts of ERP (<https://hackernoon.com/how-erp-bridge-can-push-your-business-to-the-next-level-uu9q32tv>)

ERP itself basically emphasizes the word “Planning” or planning, so this aspect plays an important role in it [4]. In a simple ERP it can be described as an information system within a company that is designed to integrate/coordinate all available resources or company resources with all information and activities in the company to create a complete business process [5]. Here ERP will integrate all divisions/departments in the company into a system that (later) will be able to serve (almost) all the needs of the company in each division [6]. ERP in its current implementation is not only limited to the manufacturing industry, in businesses that do not involve the production process in their activities ERP can also still be used, with customization/adjustments to the modules used in Figure 3.

In carrying out its functions the ERP software has a variety of modules to handle different transactions, and some of the main modules that are usually present in this ERP system are as follows:

1) Finance, which provides various financial management functions and analytical support, consists of a series of sub-modules such as Financial Accounting, Treasury, Enterprise Controlling, and Investment.

2) Sales & Distribution, which aims to support the company’s sales and distribution activities and consists of sub-modules such as Master Data Management, Order Management, Shipping, Billing, and Pricing.

3) Production, which is used for a series of production processes with sub-modules including Material & Capacity Planning, Engineering & Data Management, Quality Management, Cost Management, Engineering Cost Control, and so forth.

4) Human Resources, which are used to manage personnel affairs with sub-modules such as Payroll, Business Trip/Travel Management, Compensation & Benefit Management, and Employee Development.

5) Material Management, usually related to the entire process of planning, purchasing, and procuring material.

Besides the modules above, there are still other types of modules offered by each ERP solution provider company such as Quality Management, Facility Maintenance, and Supply Chain Management. Each company usually has different needs according to their respective types of business; therefore, ERP systems are usually offered with 2 types of software, namely finished software and custom software. Specifically for this type of software modification it usually requires several stages in the manufacturing process, especially an in-depth understanding of the business processes of the company that will use it, so that there are no mistakes in the development process later. Errors during

development can result in large losses in terms of time and cost, because usually the order software is more expensive and also the manufacturing time is relatively long [7].

In companies engaged in the ERP trading sector, they can cover a full business cycle from receiving POs from customers, to invoice the customer. When a salesperson receives a certain PO material from a customer and is inputted into ERP, then it can be seen the position of the availability of goods in all warehouses in the company, and if the desired product location in one warehouse has been determined and inputted into ERP then it will be a sales order that is created, and at that moment the part of the warehouse in question will immediately receive information that there is an order for a number of products contained in the warehouse, completed with the buyer's name, shipping address, and planned delivery time. At the same time, the finance department also immediately receives information that there are a number of orders for certain products of value coming from certain customers with certain payment systems (cash or credit), for further processing whether there is an incoming payment worth the order if the transaction is cash, and if the non-cash system will be validated by the ERP system, whether the same customer still meets the requirements for credit transactions at that time, in relation to the invoice status that is past due, or the limit of available credit facilities. Furthermore, the warehouse will process the incoming sales order to make a delivery order or what is commonly called a delivery order in the ERP system, which contains some of the information from the sales order (product type, quantity and time of delivery plan), and also information from others such as the fleet that will be used for the shipment (for example, a truck/car box type vehicle with a specific number plate that has been previously registered in the ERP system). If the sales order was apparently not validated by the ERP system because for example there are invoices that are due and not paid by the customer, then automatically the delivery order cannot be made by the warehouse, so here there is a control function. After the delivery order is created and the goods have been removed from the warehouse according to the order (usually known as the goods issue in the ERP system), it is said that the delivery order has been completed/complete.

At that time also after the goods issue process is inputted on the ERP system, the finance department will immediately get the information/data in real time that the order has been sent to the customer, and immediately after that the billing process can be done on the ERP system for printing invoices to customers with value according to the quantity of goods sent. In some ERP systems billing can also be done automatically as soon as the goods issue process is complete. At this stage the transaction is automatically recognized as a sales at the company, and accounts receivable if the transaction is done on credit.

For other examples of integration with HR, for example, in the example above when a salesperson gets a PO from a customer, then in the sales order created, one of them contains information about who the salesperson got the PO, so that at the same time the performance of a salesperson can be measured in the period a certain time, which can be seen from the total transaction value obtained, or the quantity of products it sells, and compared to the KPI target of the salesperson. This can be used as a basis for calculating incentives for the salesperson, or as one of the considerations for determining the best salesperson for a certain period of time, for example.

For the marketing division, sales order data within a certain period can be analyzed to find out important information such as which products sell best/not sell, products that contribute the greatest profit or revenue, how the distribution of products in certain geographical areas, who are the customers with most purchases, and even at the time period where sales peak. Based on these data marketing can develop promotional programs for specific products/regions, evaluate the effectiveness of ongoing product promotion programs, and many more business intelligence that can be obtained as a basis for decision making at the management level.

Operation division can also get a lot of information from sales order and delivery order data at certain times. For example, evaluating which warehouse locations have the densest shipping activities, what is the average time difference between the planned delivery schedule and the actual delivery time (planning delivery vs. actual delivery), the total number of goods transported for each mode of transportation used, the shipping area furthest that can be reached by a warehouse, the movement of stock of each product in each warehouse. Even the ritase of each truck fleet at a certain time can also be evaluated. All of this data can be used as a basis for evaluating ongoing business processes to optimize existing processes.

ERP implementation is usually indeed not easy; therefore, it takes a lot of considerations that are really mature before the company decides to implement this ERP. By making the right planning methods and learning a lot from companies (especially similar ones) who have already implemented ERP will be very helpful in reducing the occurrence of failures in the implementation of this system.

According to research from Hwang and Min [8] they found that the driving factors for ERP implementation include:

1) ERP adoption and implementation depends on the company's internal conditions, where the company's external conditions only have a small and indirect effect on this driving factor.

2) Without top management support, adaptive organizational culture, open communication, business process re-engineering (if needed) and supporting ICT facilities and infrastructure, companies will experience difficulties in obtaining maximum benefits from the implementation of this ERP.

3) Before making a large investment in the implementation of this ERP the company should make a comprehensive analysis of whether the ERP is suitable for the company.

4) ERP can also increase the capabilities of the company's suppliers, as well as of course increase the capabilities of the company itself. Here the capability of the supplier is the accessibility of information for the supplier, improvement of existing processes, and product innovation. In short, ERP implementation can also create a "win-win" situation for companies and their suppliers, while increasing the performance of the company's supply chain.

Based on the results of the research above, the company needs to do the following things before the adoption process, the company needs to make a feasibility study, where usually one of the inhibiting factors of ERP implementation is expensive initial costs and time of return, opportunities for collaborative partnerships with existing suppliers in the company, planning education/training for potential users, as well as methods/parameters to measure the effectiveness of the use of ERP later.

The purpose behind these things is a feasibility study carried out to see the company's existing condition before ERP, how the business character of the company is now and the business development plan in the future, how is the IT infrastructure in the company today, what is projected to be replaced/added to the implementation of this ERP, and do not forget the culture of the company itself. To study partnership collaboration opportunities will increase opportunities for suppliers to share information with companies and increase the speed of supplier involvement in product development through this ERP path. Training for users is also important to improve the familiarity of ERP users later and also reduce the concerns that may arise over the implementation of this ERP [9].

According to Elmonem et al. [10] ERP implementation can be divided into 5 main stages, namely:

- 1) Feasibility study
- 2) Planning phase/planning
- 3) Decision for implementation
- 4) Implementation management of implementation itself, and

5) Post-implementation phase, including evaluation of ERP project success

In the process the involvement of company workers in using ERP is also influenced by various factors, where the commitment of workers and their level of involvement is influenced by a factor called ERP Leadership [11]. Another source also mentioned that the commitment and involvement of workers is very important for the success of initiatives in the organization, one of which is the implementation of ERP [12]. This involvement is also an impetus/motivation that influences the process of absorbing ERP systems in the company [13,14]. If a company has decided to be ready to use ERP solutions in its business activities, the next question is to decide which ERP solution to use among ERP solution providers in the world.

For this reason, companies need to consider the following aspects:

1) Key capabilities to support all of the company's supply chain activities starting from suppliers, production, distribution and consumers. These factors are also adjusted to the character of each industry that exists coupled with a structured implementation methodology that makes it possible to create appropriate and effective solutions for the company.

2) Capacity to handle customer orders, manufacturing processes, and complexity of the products produced. ERP solutions must be believed to be able to accommodate a variety of product lines from the company along with all of its derivatives, so that the entire process can really be fulfilled by one ERP solution chosen, from upstream to downstream.

3) The ERP solution chosen must be able to fully integrate the cycle starting from production planning and flow, in line with customer orders, inventory management, transportation/shipping, financial and accounting transactions, so that overall benefits can be felt.

After the company decides which ERP solution to use, what can actually be expected by ERP solution users in a specific industry? One thing that is certain is the creation of an easy access to information in real time, where manufacturing planning, customer orders, procurement & materials, and business processes can all be integrated.

With integration, in general the following things can be created:

- 1) Optimization of production planning and steps to improve efficiency
- 2) More efficient distribution and tracking of orders
- 3) Order fulfillment and better shipping planning to create customer satisfaction
- 4) More accurate forecasting for better short-term and long-term planning
- 5) Better order management for increased production flow
- 6) Information quality related to better company performance for better strategic decision making.

For this reason, although ERP implementation is one of the major investments, if it is implemented properly, ERP will provide sustainable added value for the company [15]. One tangible benefit can be seen if the ERP system is integrated with Business Intelligence it will be able to provide very complete and comprehensive insights for decision makers. Sales trends, price patterns formed over a certain period of time, forecasting, low-peak season analysis, all can be clearly seen with the integration between ERP and Business Intelligence.

ODOO

ODOO is an Open Source ERP platform that consists of a variety of different modules that can be selected to be used according to the company's business needs. There are more than 30 main modules available, not to mention the many supporting applications available because they are open source. The platform can be used on-premise (at the user's location) or cloud based. Users are required to pay a license depending on what modules are used and how many modules are used. See Figure 4.

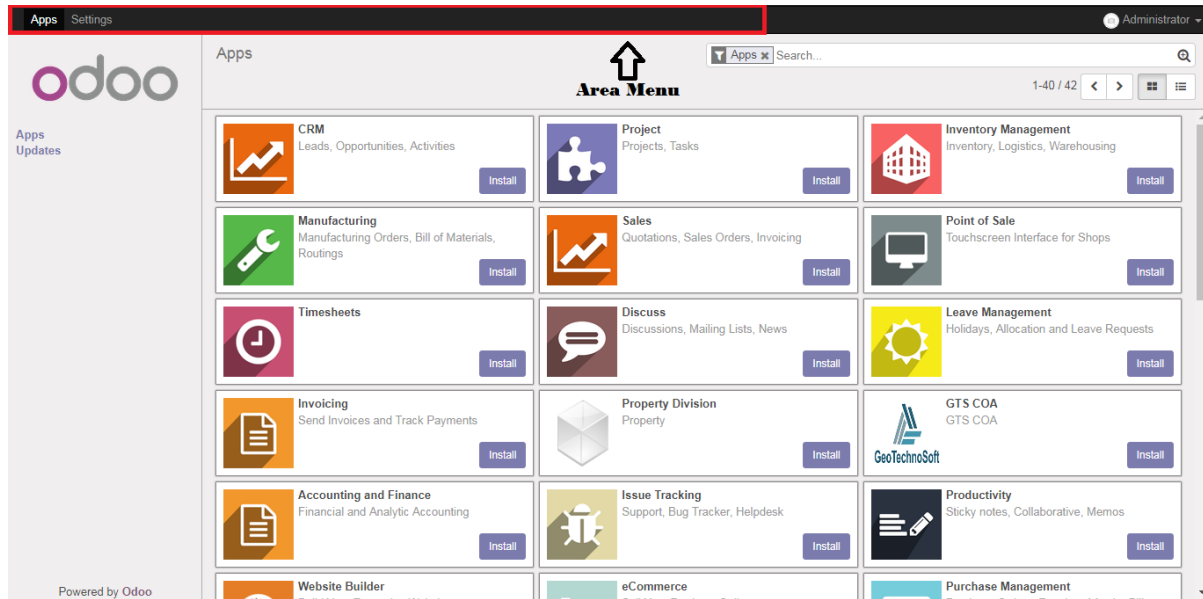


FIGURE 4. Display of the ODOO interface (<http://www.odoo.com>)

SAP Business One

SAP Business One is intended for companies that are just moving from an entry level system. This system consists of many core modules such as Sales & Distribution, Financial, Human Resources, Production, and Reporting. Existing modules can be customized to suit existing business needs. SAP Business One is one of the simple ERP models compared to other ERP solutions and is suitable for use in straightforward businesses. See Figure 5.

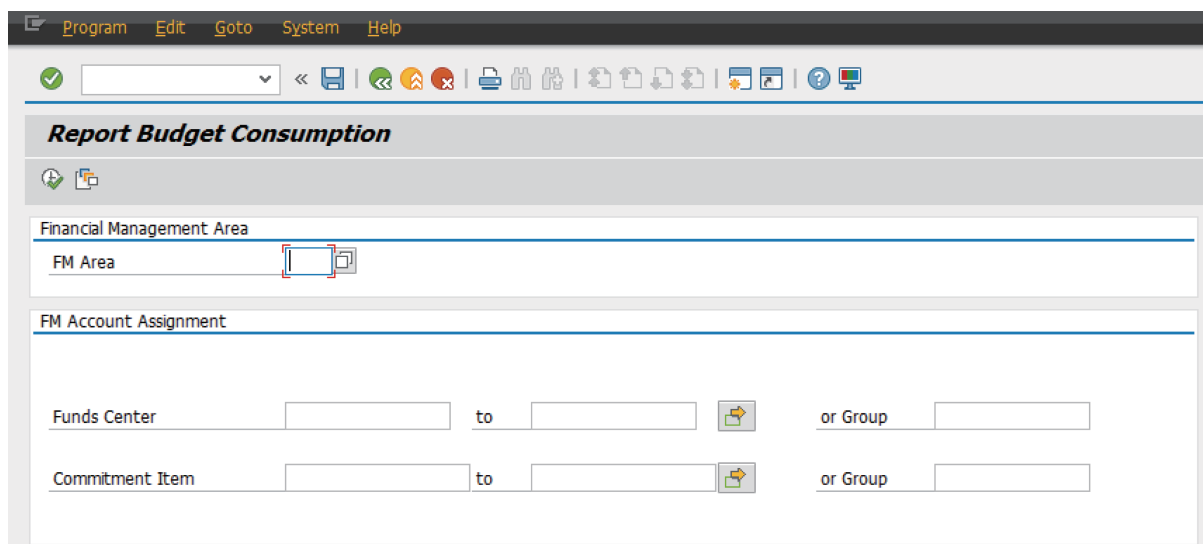


FIGURE 5. Display of MySAP interface (user screenshot)

Oracle NetSuite

For Oracle, it is targeted at medium scale businesses that are developing towards large scale, where Oracle uses cloud-based systems. Its modules include Financial Management & Planning, Order Management, Production Management, Supply Chain Management, Warehousing and Procurement. See Figure 6.

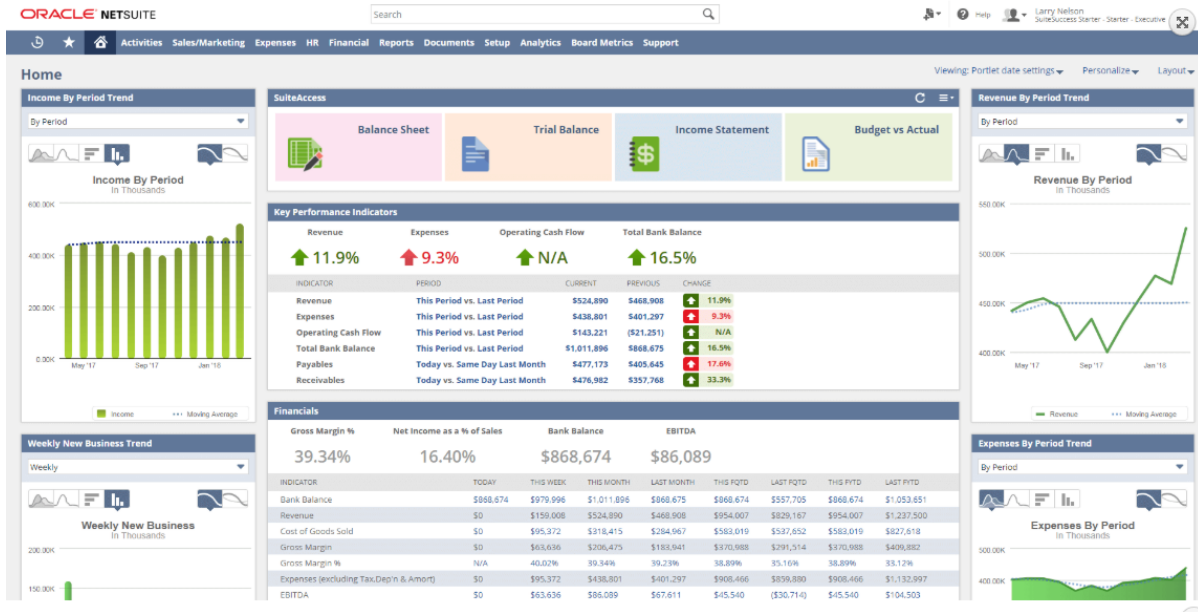


FIGURE 6. Display of Oracle NetSuite (<https://www.netsuite.com/portal/resource/articles/erp/what-is-erp.shtml>)

SAGE 200 Cloud

SAGE 200 Cloud is intended for medium to large scale businesses in the UK. This solution provides comprehensive modules that can be customized and integrated with other SAGE output products such as CRM and Payroll, and can also be integrated with Microsoft Office 365 so that it can do data processing and communication directly with Outlook and Excel. See Figure 7.

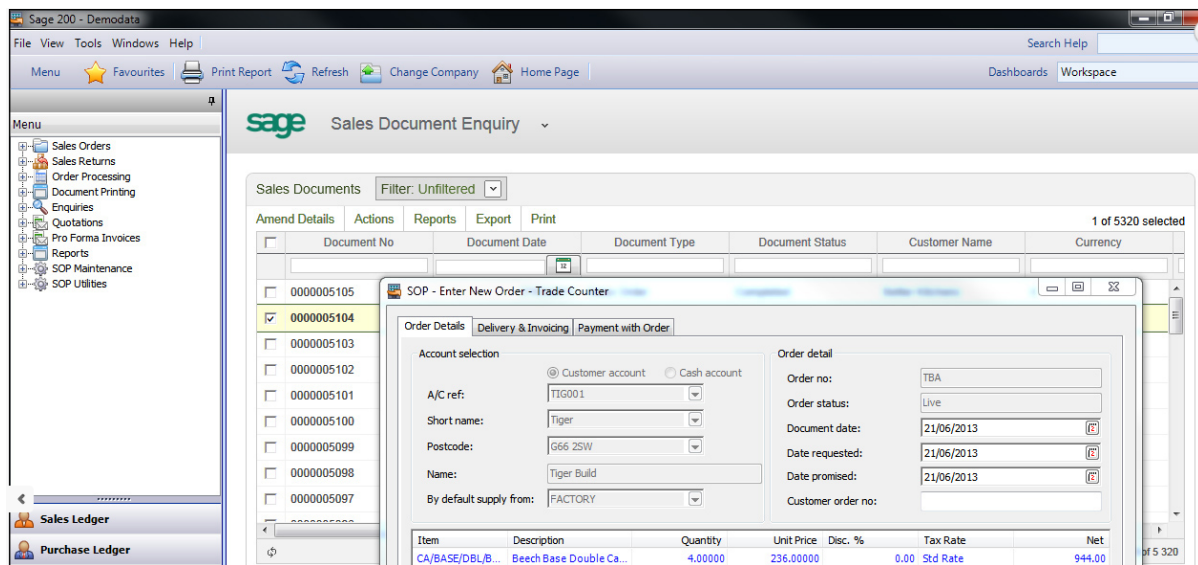


FIGURE 7. Display of SAGE 200 Cloud interface (<http://www.zdnet.com>)

Microsoft Dynamics 365 Business Central

Microsoft Dynamics is the latest product from Microsoft that integrates a comprehensive solution to manage Finance, Sales, Operations, Customer Service, etc., from 1 platform and can also be customized as needed. Of course there is integration with other Microsoft products such as Office 365 and Share Point, making it suitable for companies that have used Microsoft products before. See Figure 8.

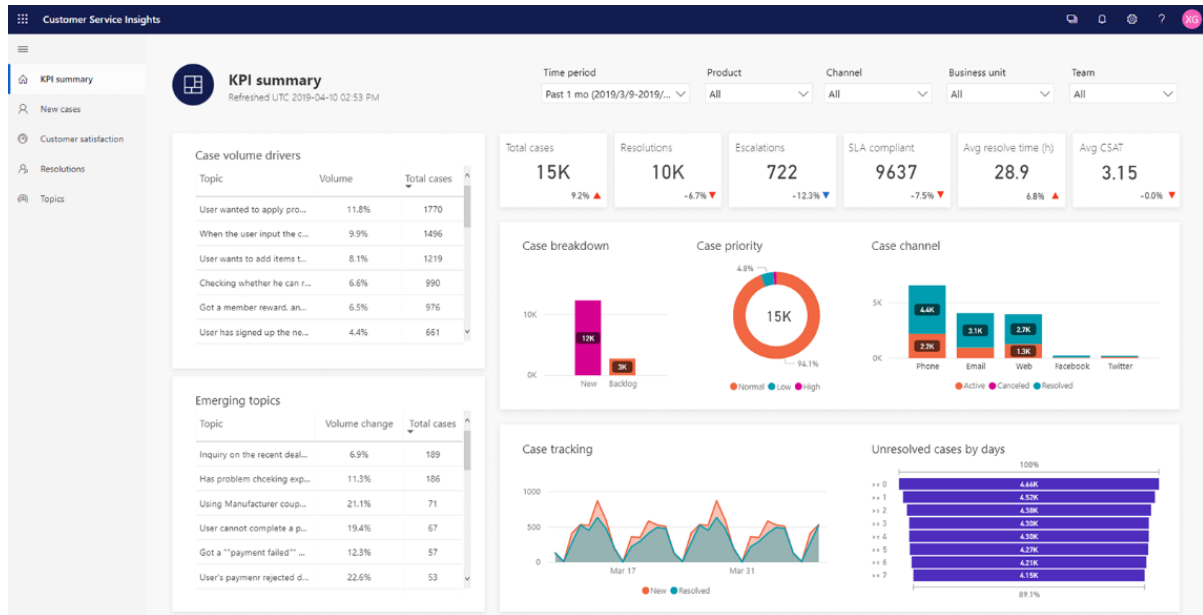


FIGURE 8. Display of Microsoft Dynamics 365 (<https://dynamics.microsoft.com/en-us/ai/customer-service-insights/>)

5. Conclusions. To be able to gain a competitive advantage in competition in the industrial era 4.0, companies must be able to optimize their resource use planning from the various divisions involved so that it is possible to get the most optimal value chain activities in terms of operations and costs; therefore, we need an integrated system that can handle the main processes in the company's value chain and can produce feedback in the form of data that can be processed for the purpose of evaluating and improving the performance of each division involved, so this is where the role of the ERP system is through various software tools, which are expected to answer the company's needs to be more competitive in this 4.0 industry era. In implementing this ERP the company also needs to consider factors related to people, processes, technology, and governance. These four factors become very important in the sustainability of ERP system implementation. Furthermore, ERP system performance measurement also needs to be done with key performance indicators standards that are clearly defined, measurable and quantitative in nature. This performance measurement is important to maintain the sustainability of the ERP system and the achievement of critical success factors as desired by the organization in an effort to achieve competitive advantage in the industrial revolution era 4.0.

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