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A Technical Infrastructure to Integrate Dynamics AX ERP and CRM into University Curriculum

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Abstract

Enterprise Resource Planning and Customer Relationship Management are becoming important topics at the university level, and are increasingly receiving course-level attention in the curriculum. In fact, the Information Systems Body of Knowledge specifically identifies Enterprise Architecture as an Information Systems-specific knowledge area. The revised Information Systems Curriculum Guide from 2010, sponsored by the Association of Information Systems and the Association of Computing Machinery, suggest Enterprise Architecture as a required course with Enterprise Systems and Business Process Management as suggested electives. Implementing the aforementioned courses into the curriculum poses challenges such as providing necessary resources, overcoming institutional constraints, and the lack of hardware architecture for advanced systems such as Microsoft Dynamics AX. This work addresses three critical issues. First, we provide a suggested technical architecture built upon the Windows Server family and Dynamics AX which may be used to implement ERP and CRM, based on Dynamics AX, into the classroom. Second, we demonstrate connectivity between an installation of Dynamics AX 2012 R3 and CRM 2011 in the cloud using the Microsoft Connector for Dynamics. Finally, we suggest a sample scenario and case for implementing ERP and CRM concepts into the university curriculum.

Keywords: ERP, CRM, Dynamics, AX, Architecture, Infrastructure, Curriculum

1. Introduction

The ongoing revolution in technology continues to remake university and college curricula, particularly in colleges and schools of business. Enterprise Resource Planning (ERP) is becoming an increasingly critical topic in Information Systems curricula as employer demand for knowledgeable and qualified employees rises. The 2013 Information Systems Job Index, from the Association for Information Systems (AIS) and the Fox School of Business at Temple University, states that systems analyst is the most common profession for information systems majors (Mandviwalla, Harold, Pavlou, & Petrucci, 2013). According to the U.S. Department of Labor's Bureau of Labor Statistics (bls.gov, 2012), systems analysts work on programming, infrastructure, installation, and testing among other tasks. An organization's ERP system is likely its largest computer system because ERP impacts all facets of business from accounting and finance to manufacturing, HR, management, operations, purchasing, etc. Based on this, the need for ERP in the curriculum is evident.

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IS curriculum guides have changed repeatedly over the years, responding to the changing needs and environment of industry. In 2005, the Association for Computing Machinery (ACM) created the Information Technology Volume for Computing Curricula (Curricula, 2005) which listed Enterprise Systems as an optional course in the Systems Integration and Architecture Track. In 2010, Association of Information Systems (AIS) and the Association for Computing Machinery (ACM) posted the IS 2010 curriculum guidelines (Topi et al., 2010). Enterprise Architecture advanced to a core IS course. Enterprise Systems along with Business Process Management became sample elective courses. Enterprise Architecture is designed with student learning objectives such as frameworks for infrastructure management, IT investment, as well as data and information architecture. One topic covered in Enterprise Systems is legacy system integration. Integrating legacy, or mainframe systems, with more modern ERP systems has become standard operating procedure in many organizations.

SAP has places itself at the forefront of ERP in the university curriculum via the SAP University Alliance where SAP charges a yearly fee. For this fee, the university is provided with training and curriculum resources. Besides training and curriculum, SAP hosts the ERP system from SAP University Competence Centers around the US and the world. SAP can be seen in the curriculum and literature via (Antonucci & Zur Muehlen, 2000; Becerra-Fernandez, Murphy, & Simon, 2000; Johnson, Lorents, Morgan, & Ozmun, 2004) as well as a Communications of the Association of Information Systems report (Bradford, Vijayaraman, & Chandra, 2003).

The Enterprise Systems course is directly related to ERP with learning objectives covering topics such as implementation, key concepts from functional areas, evaluation of enterprise software providers, etc. An additional objective is integrating functional systems into a single enterprise-wide information system. ERP is an enterprise-wide information system. The business process management course demonstrates the demand for information systems students who understand and can manage the processes in a business firm. In this track, we see ERP appearing in required courses and interwoven into electives thereby becoming an integral aspect of information systems curriculum.

According to Forbes (Forbes, 2013) top ERP vendors include Microsoft, SAP, Oracle, Infor, and Sage. Microsoft provides the Dynamics product line, including Dynamics AX for Enterprise Resource Planning and CRM for customer relationship management. While SAP is the current market leader, Dynamics products have been making gains in their respective domains (ERP and CRM). One of the powers of the Dynamics product suites are their familiarity to the user. The look and feel of the Dynamics AX client resembles other Microsoft products, facilitating the task of learning basic navigation. In addition to its ease of navigation, Dynamics AX also offers the advantage of ready customizability. With vendors such as SAP, employees must be trained in a proprietary language, ABAP. In contrast, Dynamics AX can be accessed with the standard Visual Studio tools with which most developers are familiar. Visual Studio is also taught in many technical, community college, and university environments. Microsoft also reports that implementation time for Dynamics is much shorter than its competitors; therefore, adopters save money and time on the implementation process as ERP implementations may take years to complete.

2. Related Work

Dynamics AX courses are in the beginning stages, supported by a new Microsoft Dynamics Academic Alliance (DynAA) to promote Dynamics products in higher education. It is no secret that SAP has been active with colleges and universities for many years. Microsoft is now seeking to strengthen its relationships with students and faculty at higher education institutions around the globe. One example is a student certificate program in which a student will earns a certificate in Dynamics after taking courses that have a combined 100 hours of Dynamics instruction.

ERP growth in industry now requires more staff to understand and implement ERP concepts and systems. However there is an ongoing shortage of Dynamics-proficient staff globally (Badagandi, Upadhyaya, & Patil, 2013). Dynamics AX instruction has been added at institutions such as Duquesne University in Pittsburgh, PA. In this course, AX concepts are introduced and applied to Enterprise Systems concepts such as Project Management, Change Management, and security (Nightingale, 2014). Courses have also been presented based on Microsoft Dynamics GP, a small to mid-size ERP system, where crucial ERP concepts are integrated with GP. Topics are based on the GP modules and include modules

on HR, Manufacturing, and Sales (Kim & Kim, 2014).

3. Technical Architecture

Universities are reluctant to permit faculty to run servers and services on production networks. For example, a university's Active Directory Infrastructure (domain, users, sites, etc.) are highly guarded for security and reliability. University Information Technology departments are reluctant to grant faculty access for experimental installations. Additionally, university level IT departments do not have the knowledge or skillsets required for Dynamics AX implementations. This leaves faculty in a position of performing installation and administrative tasks in order to implement Dynamics into their courses. Unfortunately, administrative tasks such as these are rarely valued in the university tenure and promotion process. In addition, mastering the technical implementation details as well as the functionality of the Dynamics software require vastly different skillsets. In order to bypass these hurdles, SAP uses competency centers which provide infrastructure, software, administration, and support (SAP, 2014). Production ERP services are available via the Internet and faculty are shielded from the technical complexities of offering such a solution in the classroom. The technical architecture presented here is designed to serve as a template for faculty to implement Dynamics outside of university constraints with the exception of access to the physical and logical TCPIP network in a manageable scenario.

The basis for the technical architecture is the Microsoft Windows 2012 Server family. The installation presented was based on Windows Server 2012 R2. For AX to function, there are many critical backbone services that are required. First, Windows Server 2012 must be installed. DNS is required for Active Directory and Microsoft SQL Server is required for Dynamics AX. Upon installing the Windows 2012 Server, DNS, or domain name service, must be added and configured. DNS is a service that performs name resolution by mapping computer names to IP address and vice versa. DNS is required for name resolution to function within the Dynamics environment. Active Director is an LDAP (lightweight directory access protocol) compliant directory service for managing accounts and groups such as user accounts, computer accounts, and security groups. Active Directory (AD) must be installed and configured and may be completed through the Server Manager Dashboard by the Add Roles of Features option or by running DCPROMO. MS Dynamics AX requires MS SQL server to be installed as a prerequisite. SQL Server 2014 is deployed in the technical architecture depicted in this work. *Figure 1* illustrates Server Manger with the required services installed.

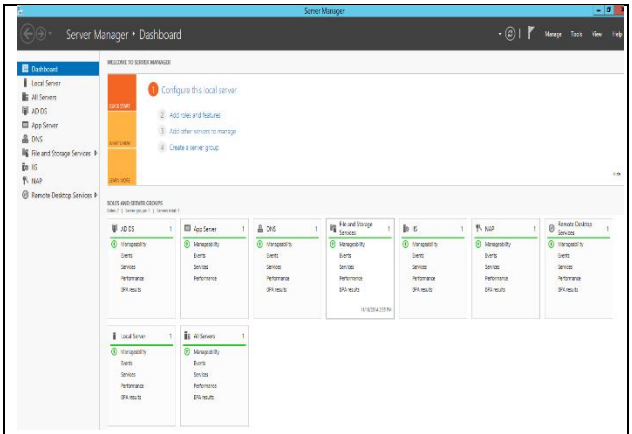

Figure 1 – Windows Services to Support Dynamics in the University Environment

University restrictions on faculty access to the hardware resources necessary for a dedicated CRM/ERP installation is a fairly common phenomenon. At the same time, having support staff who possess the skillset and/or resources necessary to install, configure, and maintain a Dynamics architecture is far from common. Budgets in academics institutions continue to shrink; therefore, it is unlikely for any extended training to be funded; therefore, faculty must support their courses through their own expertise and by seeking training through unconventional sources such as self-training. Members of the Microsoft Academic Alliance have access to customer source and a wealth of training materials for faculty and students in the form of online self-paced training as well as classroom materials for learning and teaching Microsoft Dynamics. Finally, there are restrictions on Dynamics AX where the client must be located on the same Active Directory Domain as the server or a two-way transitive trust must be configured.

Figure 2 depicts a technical architecture for deploying MS Dynamics AX into the university classroom. The model is designed to bypass the production university environment with the exception of access to the IP network. First, it is recommended to build the Dynamics AX environment on top of a virtual infrastructure. In the scenario presented, VMware ESXi 5.5 is employed to support the virtual infrastructure

and hosted onsite and supported by faculty and IT support.

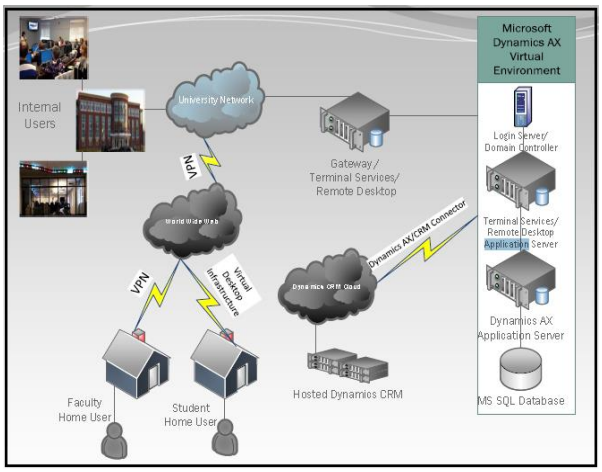

Figure 2 – Technical Architecture for Dynamics AX Deployment in a University

While this is not required, it facilitates many required tasks of any production environment. For example, the capability to quickly create a snapshot, or picture of the current state, facilitates backup. Besides facilitating backup, the snapshot can be made at the beginning of a course and rolled back to the initial state at the conclusion of the course. Additionally, the snapshot may be taken prior to a configuration change to make recovery of a fatal error much easier. VMware provides academic licensing at reduced costs. A virtual infrastructure reduces the downtime in the event of a hardware failure as a virtual server can be moved to another physical server without rebuilding the Dynamics AX environment.

Once the Dynamics Environment is installed and configured with DNS, Active Directory, MS SQL Server, Microsoft Dynamics, etc. and the AX software is tested and data loaded from the sample Contoso data, the next step is installation and configuration of Remote Desktop Services, or RDS, formerly known as Terminal Services. This is completed by opening server manager, adding roles, and then adding the Remote Desktop Services role. Once RDS role is installed and configured, licenses must be added to permit clients to connect. Licensing is available via academic licenses, the Dynamics Academic Alliance, or thorough the University's volume licensing program. Finally, the Dynamics AX client can be added as a Remote App program. The Remote App publishing is completed via selecting the server collection from the Server Manager, Remote Desktop Services, Collections, selecting the Collection configured during RDS installation and configuration, under Remote App Programs selecting the Tasks dropdown and clicking Publish Remote App Programs. This launches the Publish Remote App wizard when can be used to publish Dynamics AX as a remote application in Windows Server 2012.

At this point, VMware is hosting an image with your configuration (dual processor, 32gb RAM, 1+ TB HDD recommended) which is running Windows Server 2012 with infrastructure services (DNS, AD), SQL Server, and Dynamics AX, Remote Desktop Services, and the Dynamics AX client configured as a remote application. Next, configuration of the classrooms and laboratories to access the Dynamics AX client must be performed. University laboratories typically fall under the domain of technology support services and are reimaged every semester or every year making advanced configuration problematic. Additionally, university computers will be members of the production university AD domain and, as previously mentioned, the AX clients and servers must reside on the same AD domain. The Remote App configuration under Remote Desktop Services serves to remedy the aforementioned issues. The only configuration required of the university lab and classroom computers is locating a single text file on the computers or on a shared drive. A sample text file, with an .rdp file extension, is presented as *Figure 3.* Certain aspects of the file will differ such as remote application name and IP address for example. The basic steps for setting up the infrastructure for Dynamics AX are:

1. VMWare to Host Windows Server 2012 Installations
2. Windows Server 2012 Core Services Must be Installed and Configured (AD, DNS, etc.) in either a single or multi-server scenario
3. MS SQL Server Installed and Configured to support Dynamics AX
4. Remote Desktop Services Installed and Configured
5. Remote Desktop Services Licensing must be Installed
6. Dynamics AX Installed and Configured
7. Remote Desktop Services Configured to host Dynamics AX as an Application
8. RDP File Created and copied to lab workstations or VDI

```
redirectclipboard:i:1
redirectposdevices:i:0
redirectprinters:i:1
redirectcomports:i:1
redirectsmartcards:i:1
devicestoredirect:s:*
drivestoredirect:s:*
redirectdrives:i:1
session bpp:i:32
prompt for credentials on client:i:1
span monitors:i:1
use multimon:i:1
remoteapplicationmode:i:1
server port:i:3389
allow font smoothing:i:1
promptcredentialonce:i:1
authentication level:i:2
gatewayusagemethod:i:2
gatewayprofileusagemethod:i:0
gatewaycredentialssource:i:0
full address:s:192.168.1.1
alternate shell:s:||Ax32
remoteapplicationprogram:s:||Ax32
gatewayhostname:s:
remoteapplicationname:s:Microsoft Dynamics AX 2012
remoteapplicationcmdline:s:
```

Figure 3 – A Sample RDP File

Figure 4 – Connector for Microsoft Dynamics Adapter Configuration

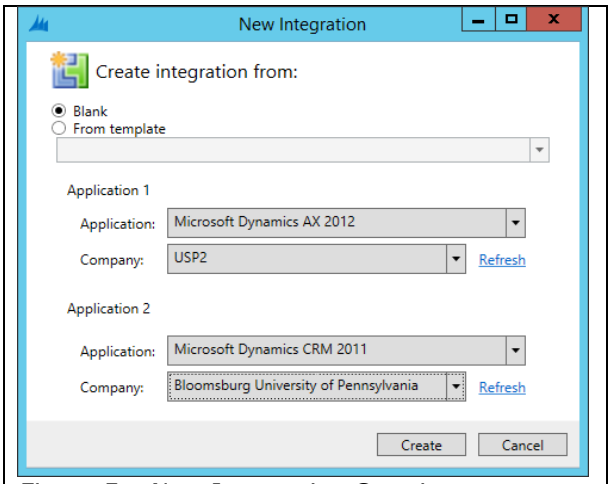

Figure 5 – New Integration Creation

4. Dynamics AX ERP and CRM Integration

Integrating Dynamics AX ERP and CRM can be achieved via the Connector for Microsoft Dynamics. In the example scenario, the aforementioned Dynamics AX environment is integrated with CRM Online. The Connector for Microsoft Dynamics is customizable depending on an organization's needs. The first step is to install the connector software and all requirements for the connector software. The Connector for Microsoft Dynamics can be downloaded from the Customer Source website by MSDYNAA members.

Once the software is installed, each system much be added in the adapter settings configuration. The possible configurations can be seen as *Figure 4.* In the scenario presented in this work, the configurations to configure are Microsoft Dynamics AX 2012 and Microsoft Dynamics CRM 2011. Configuration requires a user account to act as the connector. This use is configured in Active Directory and in Dynamics AX. This account will be used to transfer data between AX and CRM and must have appropriate access. The AOS server name, document, and services port must be setup. In the example provided, everything is based on default settings.

Following installation and configuration of the Connector for Microsoft Dynamics, a new integration must be created. In the list box of the New Integration form, the applications configured in the previous step will be listed. Choose AX to CRM 2011. This integration is bi-directional meaning a second integration is not required for CRM to AX. Once the integration has been created it is necessary to determine which mappings are required for integration. The example presented activates all maps. The maps can be configured to run at any interval required. The interval should

be set based on the amount of changes occurring between the systems. For example, if students need to see synchronized materials immediately, set the schedule for every minute. *Figure 5* details the new integration creation screen and *Figure 6* details the mapping configuration screen from the Connector for Microsoft Dynamics.

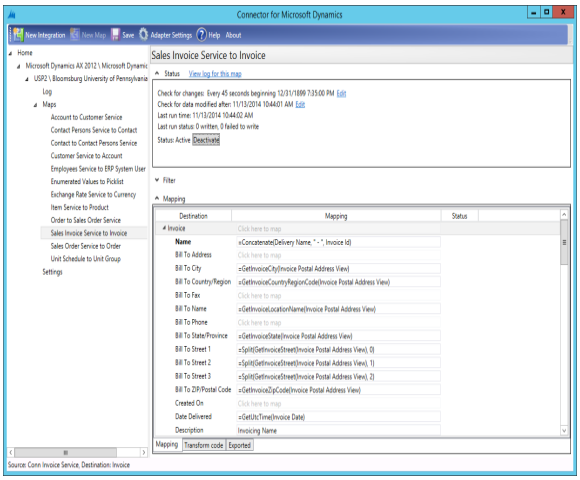

Figure 6 – Connector Mapping Configuration

5. Course Integration

One of the benefits of setting up and configuring the Connector for Microsoft Dynamics is the ability to integrate courses on ERP and CRM concepts. A key educational benefit of an integrated approach is that it replicates the real-world ERP/CRM environment. Experiential learning offers benefits such as increased understanding of the task covered in the experiential learning activity (C. Munoz & Huser, 2008; L. S. Munoz, 2010). Integration may be accomplished by offering multiple courses or by incorporating both subjects in a single course. One possibility is to have students co-registered in both courses where concepts can be interwoven between classes. This facilitates a reinforcement learning approach (Silvetti & Verguts, 2012) or a variation on the models based on the "introduce, reinforce, apply, assess" model. In order to implement integration, key or pivotal concepts can be employed between the courses. *Figure 7* shows the opening screen for Microsoft Dynamics AX 2012 R3 and *Figure 8* shows CRM Online. One such pivotal point to integrate the courses is on the sales order. If all mappings are enabled on the Connector for Microsoft Dynamics, then products from AX will populate into CRM and Sales Orders will transfer between the systems. This permits instructors to enter a sales order in one course and examine it in the other. For example, CRM may cover pre-sales activates leading up to creating a sales order. The sales order will be automatically transferred to Dynamics AX, where students in the AX 2012 course can move the sales order to production, finished goods, and finally billing the customer. This permits the instructor and students of either course (or both courses) to illustrate and investigate the relationships between sales and marketing efforts and materials procurement, logistics, and production. A sales order in this context represents a record of a promise by a seller to deliver to a buyer. Exposure to AX functionality will enable actors from the sales and marketing perspective to understand how quickly and easily the promises embodied in the sales order can be kept; exposure to CRM functionality will enable actors from the supply chain and logistics perspective to understand what will be required to fulfill the promises sales and marketing actors make on the firm's behalf.

Depending on the specifics of a given curriculum, students in the co-registered sections can reap the benefits of multiple framing: the opportunity to analyze, evaluate, and solve a problem from multiple perspectives (Colby, Ehrlich, Sullivan, & Dolle, 2011). In addition, an integrated course structure of the kind described herein facilitates the adoption of either team-based learning (Fink, Michaelsen, & Knight, 2004; Michaelsen & Sweet, 2011), problem-based learning (Allen, Donham, & Bernhardt, 2011), or collaborative learning (Alavi, 1994). Each of these methods involves students in "heads-on, hands-on" (Allen et al., 2011) problem-solving activities. Numerous studies have shown superior learning outcomes such as performance on courses assessments in fields such as physics (Hake, 1998) medicine (Albanese & Mitchell, 1993), and marketing (C. Munoz & Huser, 2008).

However, in order to yield the desired educational benefit, the experience must "work," making the technical infrastructure and implementation critical to the success of the effort. If the technology does not work as intended, the problems encountered may interfere with student learning. Although attribution theory (Folkes, 1988; Weiner, 1985) suggests that dissatisfaction with a negative experience may be reduced if the negative experience is evaluated by the customer as being outside the control of the provider, in this context the faculty member(s) are likely to be the focus of blame for failure (faculty often hold students responsible for being sure they can use

the learning management system, for example, and are likely to be held to a comparable standard by students).

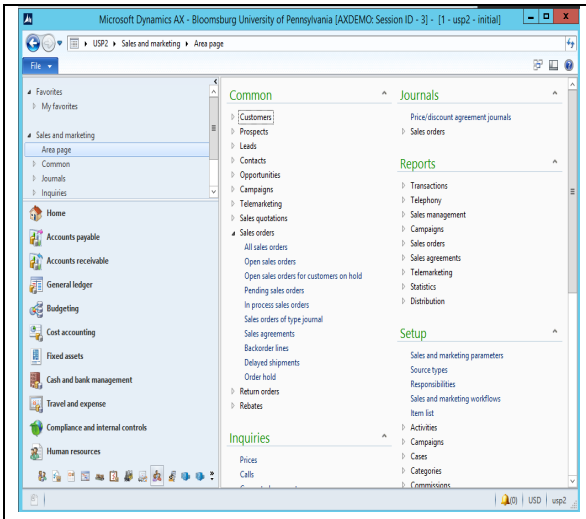

Figure 7 – Dynamics AX

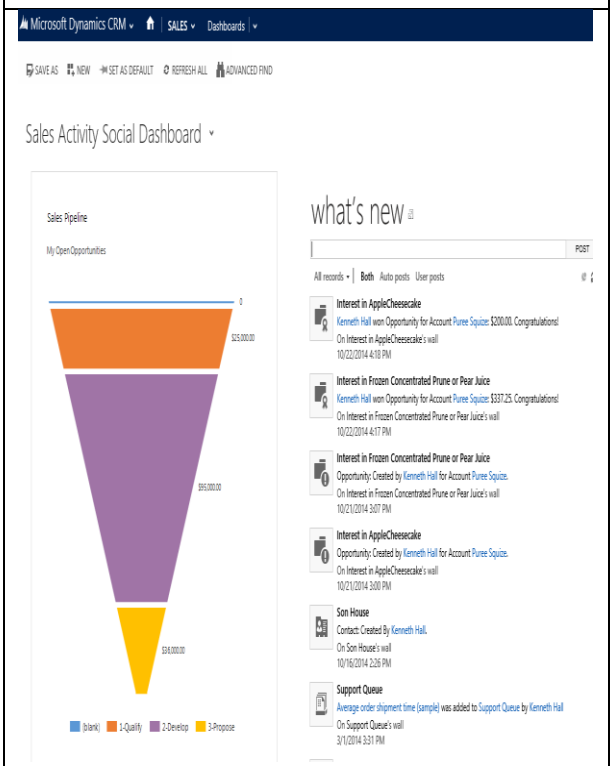

Figure 8 – Dynamics CRM in the Cloud

Figure 9 shows a sales order as a pivotal point for course integration between Dynamics AX 2012 and CRM 2011. Sales orders are required for the ERP environment as sales orders are an important concept. The sales order can be used to take students from ordering raw materials, storing the raw materials in a warehouse, paying a vendor invoice, through manufacturing, finished goods warehouse and inventory, through shipping to the customer. The same sales order may be employed in the CRM course for pre-sales activities, customer contact, demand forecasting, etc. *Figure 10* shows all sales orders in Dynamics AX 2012 R3. Orders shown in this screen are both native to AX 2012 and transferred orders from CRM 2011. Orders that begin with ORD are orders that have transferred automatically by the Connector software.

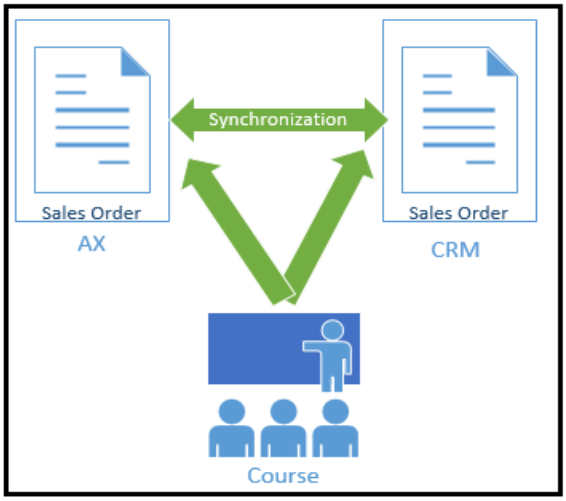

Figure 9 – Course Integration of ERP and CRM with Sales Order Course Pivot

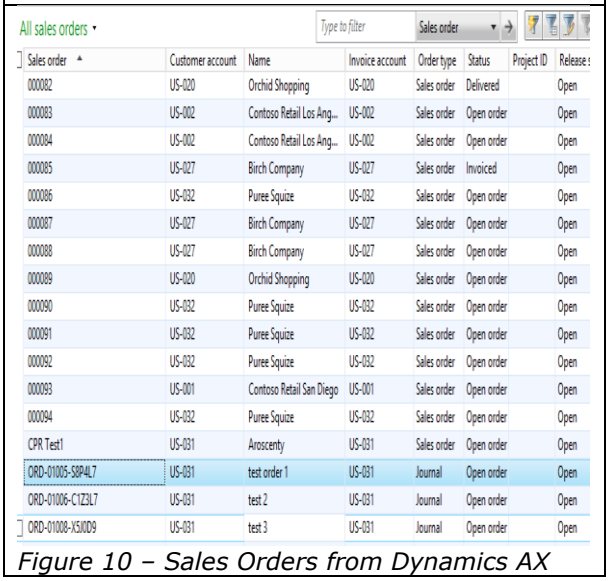

Figure 10 – Sales Orders from Dynamics AX

Figure 11 shows a specific sales order in Dynamics AX 2012. *Figure 12* shows the same order in CRM 2011. This order was generated within the CRM 2011 environment. The order was transferred to the AX environment via the

Connector for Microsoft Dynamics. During the transfer process, all required validation checks are performed. For example, the product on the sales order must be listed in the system as must the customer. Once the sales order arrives in the AX 2012 system, the order may be processed just as a sales order native to the AX 2012 system. The same is true for transferring from AX 2012 to CRM 2011.

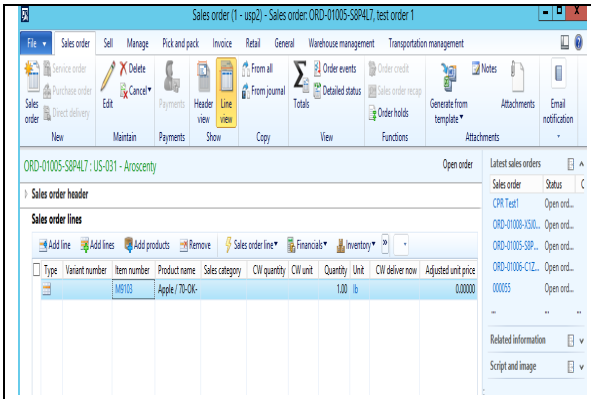

Figure 11 – Sales Order ORD-1005-S8P4L7 in Dynamics AX

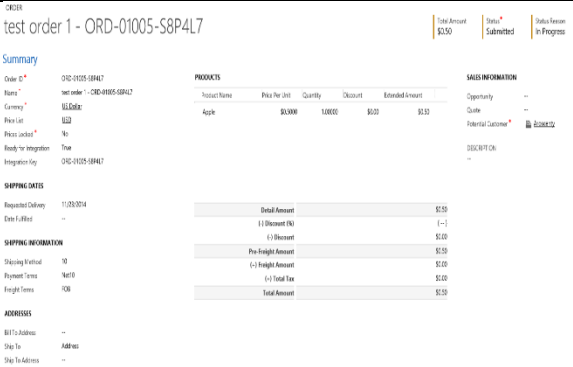

Figure 12 – Sales Order ORD-1005-S8P4L7 in Dynamics CRM

6. Conclusions

A multiple-perspective view of the interrelationships between sales and marketing activities on the one hand and supply chain and logistics activities on the other enable students to adopt a holistic view of the firm and its role in satisfying customer needs, wants, and demands. Here we have demonstrated a means by which instructors can use Dynamics AX and Dynamics CRM with the Microsoft Connector from Dynamics AX to enable students to develop a holistic perspective of supply chain and CRM issues in the face of otherwise-daunting resource constraints. This approach fits well with current trends in university instruction and is intended to meet the needs of students and employers as well as educational institutions.

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Appendix of Images

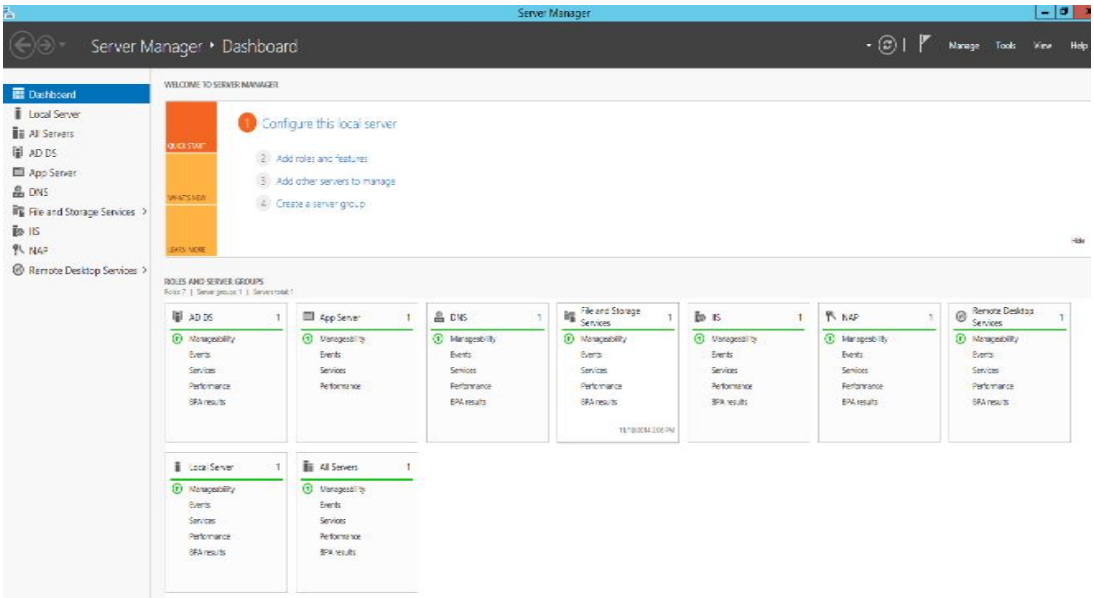

Figure 1 – Windows Services to Support Dynamics in the University Environment

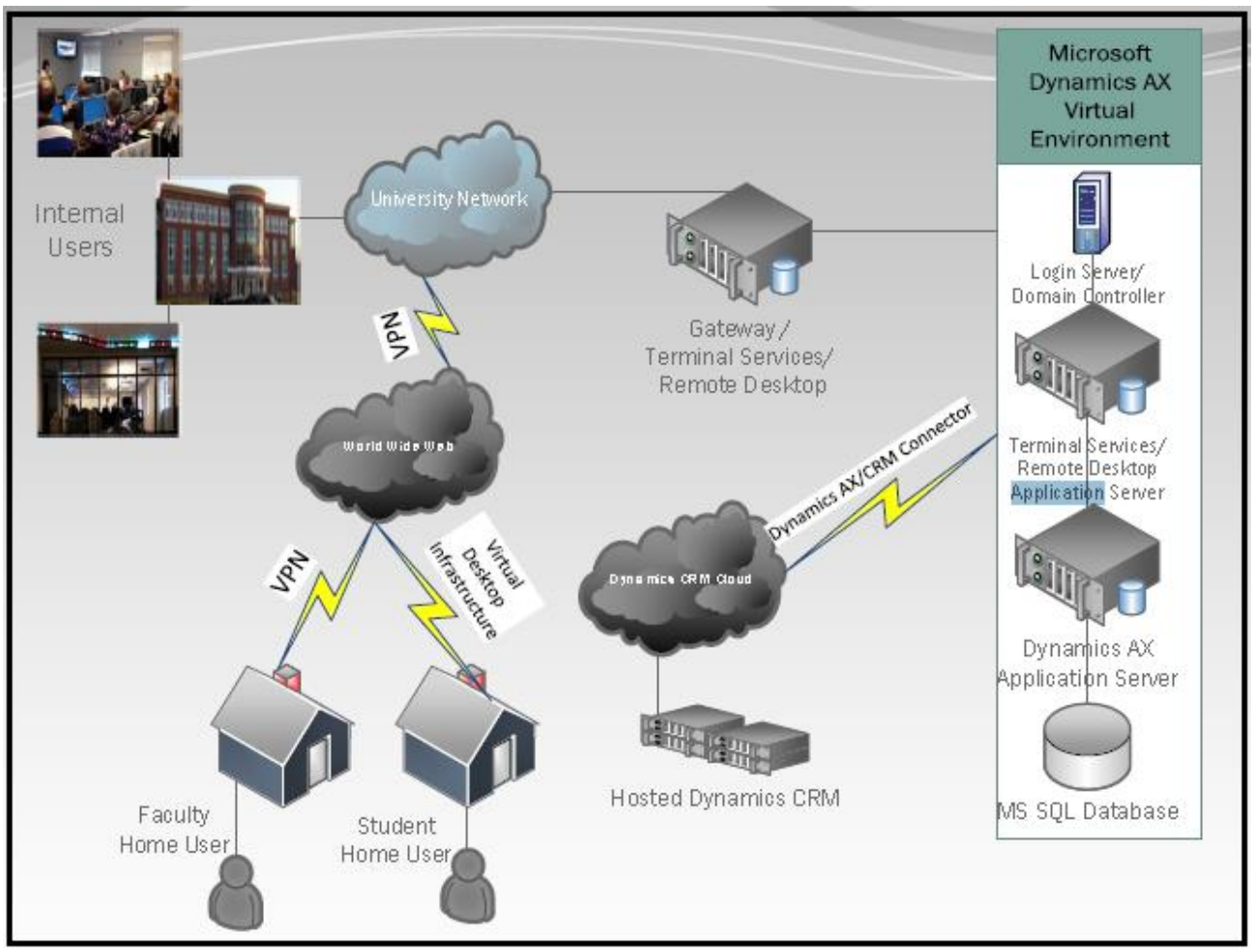

Figure 2 – Technical Architecture for Dynamics AX Deployment in a University

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redirectclipboard:i:1
redirectposdevices:i:0
redirectprinters:i:1
redirectcomports:i:1
redirectsmartcards:i:1
devicestoredirect:s:*
drivestoredirect:s:*
redirectdrives:i:1
session bpp:i:32
prompt for credentials on client:i:1
span monitors:i:1
use multimon:i:1
remoteapplicationmode:i:1
server port:i:3389
allow font smoothing:i:1
promptcredentialonce:i:1
authentication level:i:2
gatewayusagemethod:i:2
gatewayprofileusagemethod:i:0
gatewaycredentialssource:i:0
full address:s:192.168.1.1
alternate shell:s:||Ax32
remoteapplicationprogram:s:||Ax32
gatewayhostname:s:
remoteapplicationname:s:Microsoft Dynamics AX 2012
remoteapplicationcmdline:s:
```

Figure 3 – A Sample RDP File

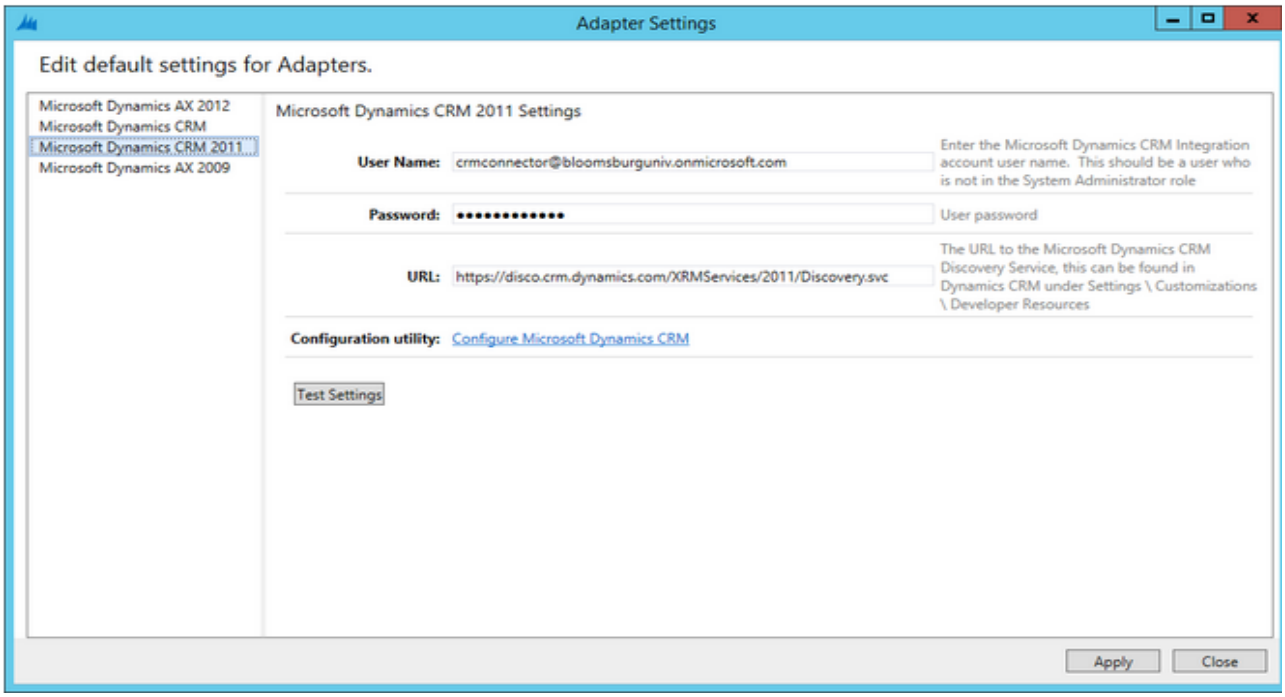

Figure 4 – Connector for Microsoft Dynamics Adapter Configuration

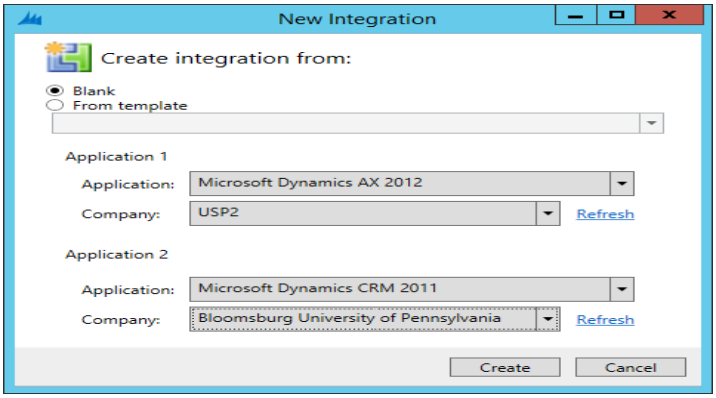

Figure 5 – New Integration Creation

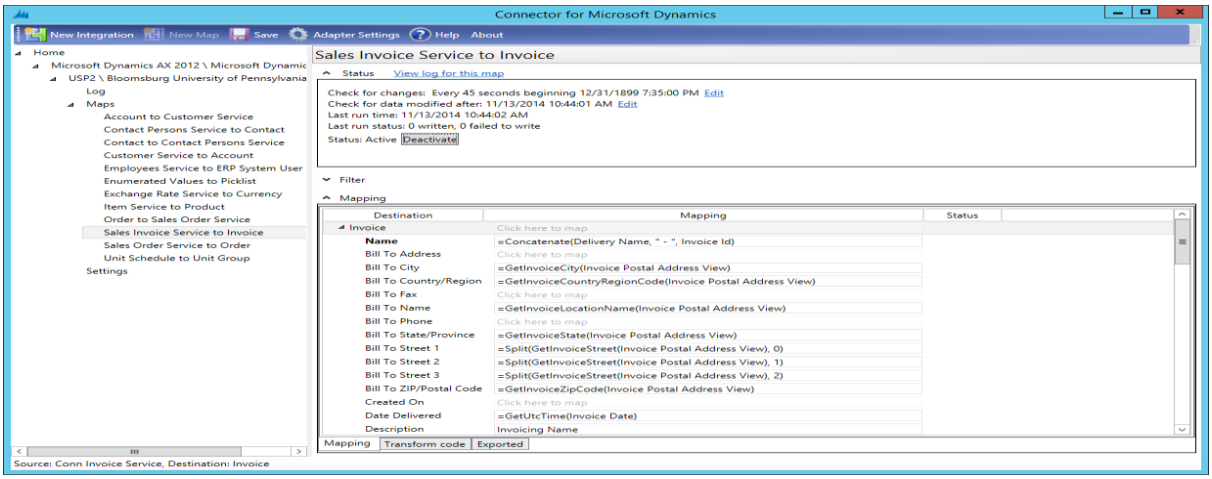

Figure 6 – Connector Mapping Configuration

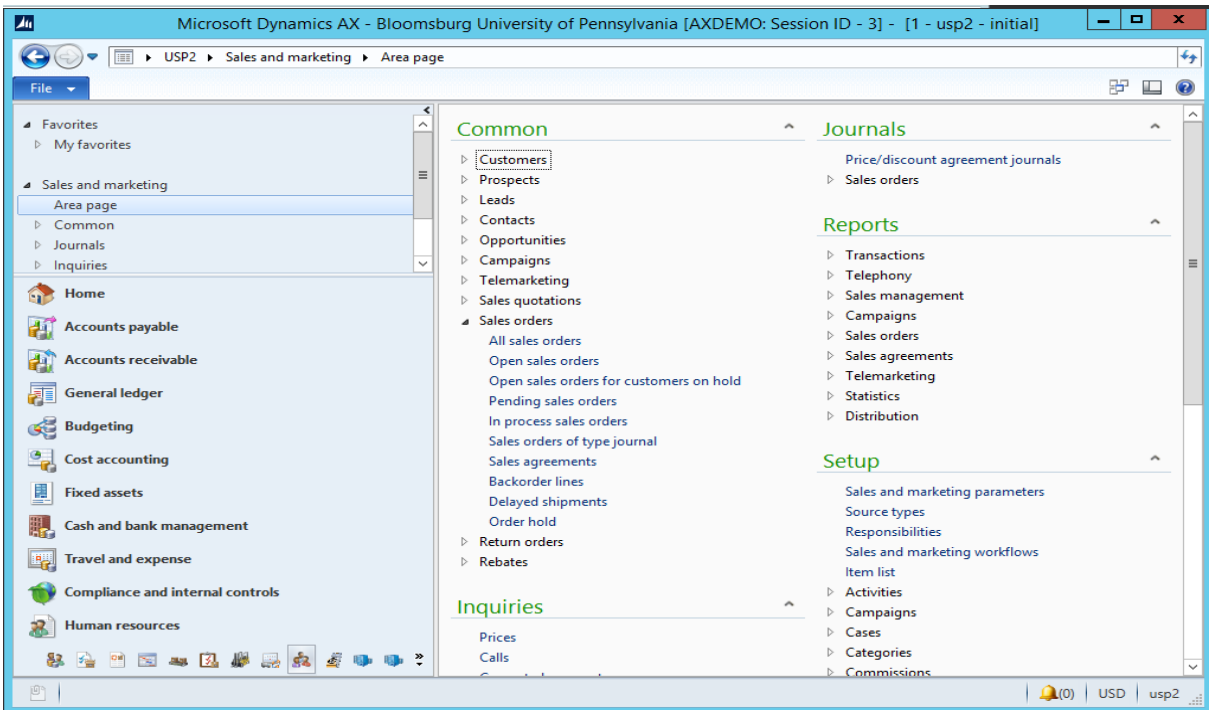

Figure 7 – Dynamics AX

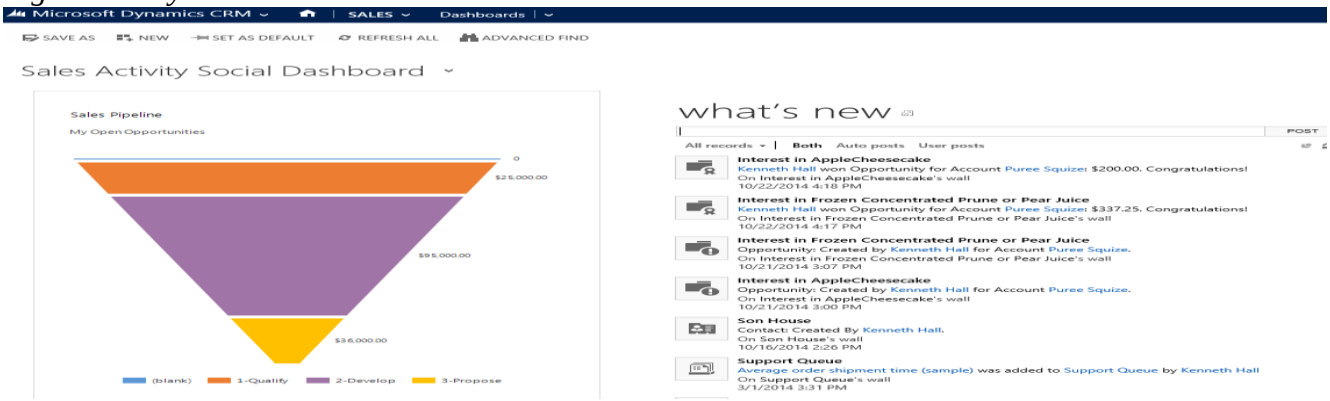

Figure 8 – Dynamics CRM in the Cloud

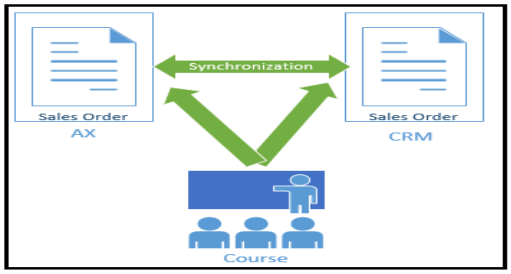

Figure 9 – Course Integration of ERP and CRM with Sales Order Course Pivot

Figure 10 – Sales Orders from Dynamics AX

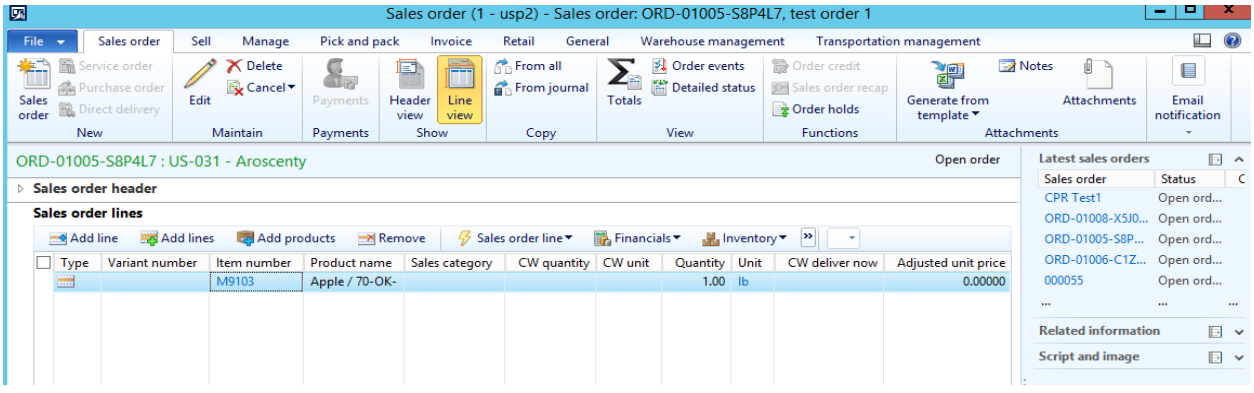

Figure 11 – Sales Order ORD-1005-S8P4L7 in Dynamics AX

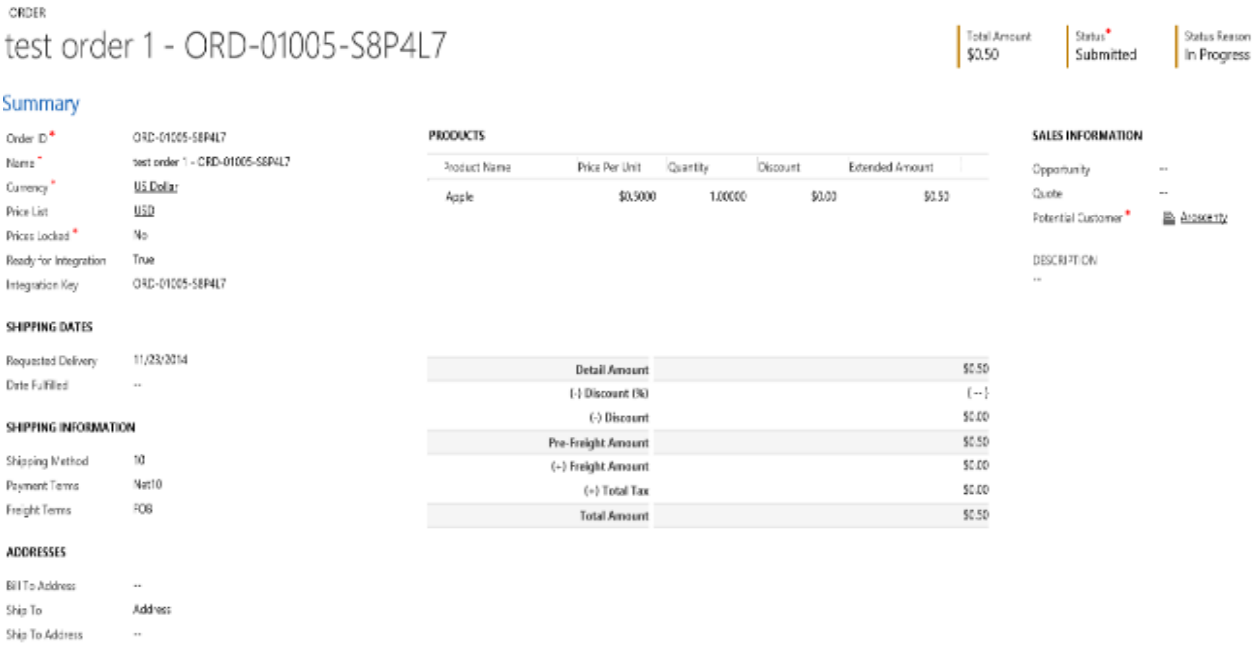

Figure 12 – Sales Order ORD-1005-S8P4L7 in Dynamics CRM