Relationships among Video Games: Existing Standards and New Definitions

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ABSTRACT

This paper identifies and defines common relationships among video games and interactive media in an attempt to improve our understanding of and support conceptual data modeling in this domain. Existing models and standards such as Dublin Core, Functional Requirements for Bibliographic Records, Resource Description and Access, CIDOC Conceptual Reference Model, and Cataloging Cultural Objects do offer a variety of relationships between resources; however, many video games are related in more complex ways that cannot be adequately represented by these models and standards, especially in ways that reflect how game players understand games and how cultural heritage institutions might curate them. After thorough review of existing standards, consultation with domain experts, and examination of sample game sets, we identified and defined 11 relationship types and 4 grouping entities prevalent in the video game domain, and offer suggestions on how these might be represented in a conceptual model.

Keywords

Video games, Interactive media, Relationships, Data modeling

INTRODUCTION

Video games are an increasingly important part of culture and society. In the United States, consumers spent 20.77 billion dollars on video games, hardware, and accessories in 2012 (ESA, 2013). Smartphones, tablets, and game consoles such as the Wii have opened up new markets for games (Newman, 2004), and as a result, recent statistics show that 58% of Americans play video games (ESA, 2013). More libraries, archives, and museums are including video games in their collections as they become increasingly pervasive, and their potential as learning and literacy tools is recognized (Gee, 2007).

Cultural heritage institutions with video game collections require robust, media-specific metadata to describe a wide variety of video games and serve a variety of use cases (Lee et al., 2013b). However, current systems and standards from both library and commercial settings fall short due to issues of inaccuracy, inconsistency, and ambiguity (Lee et al., 2013a). In response, the GAme MEtadata Research (GAMER) Group at the University of Washington Information School, in partnership with the Seattle Interactive Media Museum (SIMM), has been developing a standardized metadata schema and controlled vocabularies for video games (Lee et al., 2013a). In conjunction with this work, Jett et al. (under review) created a conceptual model for video games designed to facilitate effective description, organization, and access from a user-centered perspective. Although prior work such as McDonough (2011) offers a FRBR-based ontology for video games, their model is focuses on identification and preservation of different version of the code and their respective Representation Information, rather than how users perceive and interact with video games. The two models are related, yet serve different purposes.

During the modeling development, Jett et al. (under review) discovered that relationships among video games and interactive media need to be clearly enumerated and defined in order to fully describe games. Modeling relationships among any kinds of information objects or cultural artifacts is a fundamentally complex task. Modeling relationships among video games presents interesting challenges due to the unique nature of the media and the industrial practices surrounding them. For example, the fast pace in which game platforms evolve, often with a lack of consideration for backward compatibility, presents a challenge. Similar patterns arise in other non-textual media, such as music or film, as the devices people use to listen to music or watch movies have also rapidly evolved. However, unlike music or movies, there is no single industry standard that rules the video game market place. Platforms such as the PS3, Xbox 360, Wii, and PC present radically different software environments where no single instance of a video game media can be made that will work on all of the platforms, unlike music where the manufacturer of the disc player has no effect on whether or not the user can listen to the music encoded on the disc.

In addition, games are often released for multiple platforms at the initial release date, as well as re-released for different platforms at a later date (typically referred to as a "port" or "porting"). These new releases often include additional content of some sort, making it difficult for users to differentiate among multiple versions and identify the one most suitable for their needs. This publishing practice is also common for media such as movies, where limited editions and director's cuts abound. However, there are a myriad of ways in which a game's content can be extended, improved, or changed, making it even more difficult to capture variations from a data modeling perspective. Downloadable content (DLC) such as extra dungeons, characters, cutscenes, and costumes; additional capabilities such as online multi-player modes, new or additional achievements and/or trophies, access to leaderboards, changes in protagonist(s) and ending(s), and various user-created modifications ("mods") are just a few examples.

With the abundance of video game media and versions, users need clear and explicit descriptions of the relationships among them. This study aims to identify and define the key relationships that exist among video games, key grouping entities that result from their instantiation, and how they might be represented in a conceptual data model. These relationships emerge from an analysis of video games and our previous modeling work (Jett et al., under review). We also explore the applicability of existing data models and metadata standards for representing these relationships, and identify their gaps and limitations.

RELEVANT WORK

Treatment of Relationships in Existing Data Models and Metadata Standards

To understand how relationships have been treated in the field of knowledge organization, we explored relationships identified and defined in various data models and metadata standards. In particular, we examined Dublin Core, Functional Requirements for Bibliographic Records (FRBR), Resource Description and Access (RDA), CIDOC Conceptual Reference Model (CRM), and Cataloging Cultural Objects (CCO) because of their widespread adoption and applicability to cultural objects.

Dublin Core

With Dublin Core, it is possible to use a number of properties in the /terms/ namespace to specify certain relationships among the resources being described. The relationships that may be particularly relevant for video games are as follows (DCMI Usage Board, 2012): isPartOf, isVersionOf, and Requires. The relationship "isPartof" may be used for describing games belonging to the same series, although it is intended to describe general whole/part relationships. "isVersionOf" may be used to describe a port or remake of a game. "Requires" can potentially be used for connecting additional content to video games. "isFormatof" (reciprocal: hasFormat) may arguably be relevant. It is defined as "a related resource that is substantially the same as the described resource, but in another format." This could be used to represent ports and remakes, depending on how one defines "format." "Collection," defined as "an aggregation of resources" in DCMI Type Vocabulary, or Dublin Core Collections Application Profile[1] may also be used to represent anthologies of games.

Functional Requirements for Bibliographic Records (FRBR)

FRBR offers a set of relationship types with definitions and indication of relevant entities in the model (e.g., work-to-work relationship, work-to-expression relationship). The relationships in FRBR are designed to serve "as the vehicles for depicting the link between one entity and another, and thus as the means of assisting the user to 'navigate' the universe (IFLA Study Group on the FRBR, 2009, p. 55)." There are fifteen different relationship types specified in FRBR (i.e., Abridgement, Adaptation, Alternate, Arrangement (music), Complement, Imitation, Reconfiguration, Reproduction, Revision, Successor, Summarization, Supplement, Transformation, Translation, and Whole/part), and some of them are effectively applied to describe video games from a preservation perspective (McDonough, 2011). Some of the FRBR relationships may be used as well within our modeling scope, although perhaps not to the desired level of granularity (See Table 2).

Resource Description and Access (RDA)

Based on FRBR, RDA also offers a set of relationships (CLA et al., 2010, Appendix Section J). Relationships are organized in a hierarchy under Derivative, Descriptive, Whole-Part, Accompanying, and Sequential relationships that may exist among different FRBR Group 1 entities (i.e., Work, Expression, Manifestation, and Item). For example, "based on (work)" is a broader designator for derivative work that encompasses "adaptation of (work), expanded version of (work), remake of (work), etc." RDA prescribes "us[ing] relationship designators at the level of specificity that is considered appropriate for the purposes of the agency creating the data. (CLA et al., 2010)." Several different types of derivative and sequential relationships (noted in Table 2) seem particularly useful for video games.

CIDOC Conceptual Reference Model (CRM)

A robust model intended to represent implicit and explicit concepts and relationships in culture heritage documentation, the CRM of the International Council of Museums' International Committee for Documentation offers nearly 150 different relationships among more than 90 classes of entities. CIDOC CRM is intended to cover all materials collected and displayed by museums and related institutions, both individual items as well as collections of items (Le Boeuf et. al., 2013). Relationships defined in CIDOC CRM show exceptional thoroughness and detail in a multiplicity of aspects necessary for documenting

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[1] http://dublincore.org/groups/collections/collection-application-profile/

museum artifacts and related contextual circumstances like geographic regions, time periods, artistic movements and inspirations. However, CIDOC CRM's focus on entities like events and change over time present a barrier to describing video games as abstract objects stored on physical media and performed through an intervening entity like a computer.

Many of the relationships that appear applicable to video games break down, as their domain and ranges are frequently too narrow or inappropriate for representing relationships between abstract objects. Relationships such as P15 "was influenced by," P69 "is associated with," and P110 "augmented" all apply to specific activity or event entity types, rather than artifacts. Temporal relationships that seem capable of representing prequel and sequel relationships among games, such as P115 "finishes," P116 "starts," P117 "occurs during," P118 "overlaps in time with," P119 "meets in time with," and P120 "occurs before," all describe event entities. These relationships may be apt, as prequels and sequels often earn those descriptions based on narrative events taking place within a game. However, if games are to be described based on their status as artifacts and not as series of fictional events, then the restriction of CIDOC CRM temporal relationships to event entities cannot apply.

Cataloging Cultural Objects (CCO)
Developed by Visual Resources Association, CCO is a metadata standard describing intrinsic vs. extrinsic relationships among works. An intrinsic relationship is defined as "a direct relationship between two works" that is "essential and must be recorded to enable effective searches" (Baca & VRA, 2006, p.13), whereas an extrinsic relationship is not essential (although it may be informative). Whole-part, Group and Collection, and Series relationships are examples of intrinsic relationships that may also be used for describing video games. Additional "relationship types" are described for personal and corporate name authorities, geographic place authorities, concept authorities, and subject authorities, although these are less useful for video games in the current context. CCO prescribes using a locally developed controlled vocabulary for denoting the actual types of relationships, which is essentially what we are attempting in this paper.

STUDY DESIGN AND METHOD
Understanding relationships among video games is part of a larger research agenda surrounding the design and construction of a conceptual data model and standardized metadata schema to describe video games for cultural heritage institutions. Previous modeling work (Figure 1) revealed difficulties identifying and defining complex inter-object and conceptual relationships among games, how these relationships result in the instantiations of grouping entities (e.g. Series) aggregating games at different levels of

abstraction, and how games relate to these grouping entities. Nevertheless, representing these relationships is essential for a number of use cases (discussed in Lee et al., 2013a).

To identify and define these relationships, we used the following complimentary techniques:

1) review and harvesting of relationship classes and types from extant sources, both metadata standards and game-related online/offline resources;

2) consultation with video game experts and enthusiasts with deep domain knowledge from SIMM and local game companies in order to map and make explicit their views on how they conceptualize the entities and relationships in the domain (further discussed in Lee et al., in press); and

3) examination of video games themselves to understand both how they have been characterized in the past, and potential ways in which they could be characterized in the future.

We worked with a selection of sample game sets chosen for diverse representation of genres, platforms, creation dates, and distribution methods. Game sets sprung from a seed game known to have complicated relationships with other games and additional content. Sample game sets included (but were not limited to) *Shin Megami Tensei: Persona, Disgaea, Final Fantasy, Kingdom Hearts, Bejeweled, Civilization V, Pokémon, Super Mario Bros.* and all the related games in each series as well as additional content published for them. Through an iterative collaborative approach, we identified attributes of games that are not currently recorded in extant systems or represented in existing models, yet are critical to understanding the complex relationships in the domain (Clarke et al., 2014). In this paper, we list and define the key relationships among video games and how they may be represented in a larger data model intended to facilitate the effective description of video games, the efficient organization of those descriptions, and the development of tools to support the access of video game–related information.

RELATIONSHIPS AMONG VIDEO GAMES
Overview and Definitions
We identified a total of 11 relationship types and 4 grouping entity types that are prevalent in the video game domain (Table 1). The first four rows describe entity types or classes that group games based on particular criteria and at different levels of abstraction. For example, the grouping entity "Series" is used to aggregate video games at the "Game" level regardless of any specific "Edition" or "Local release." "Collection," on the other hand, aggregates games at the "Local release" level (see Figure 1).
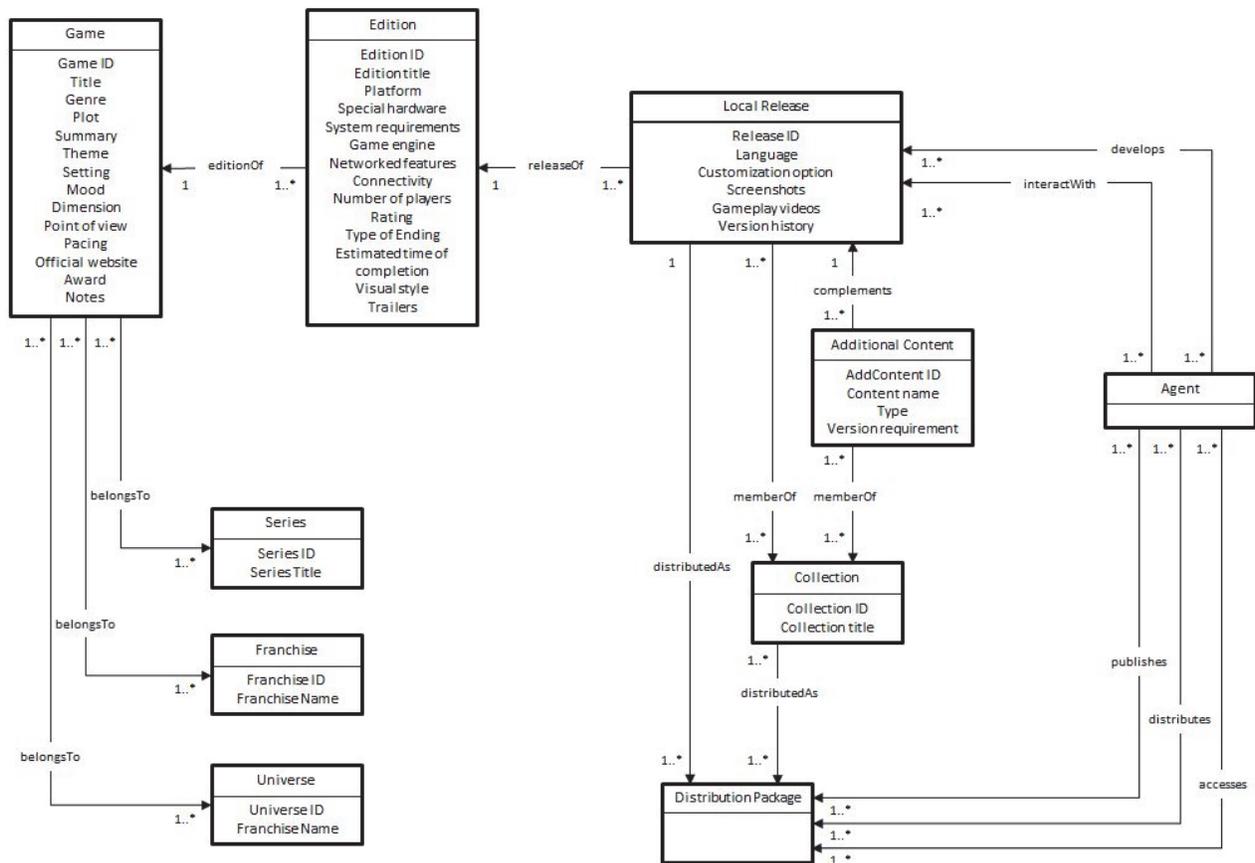
Figure 1. Proposed Data Model for Video Games (Jett et al., under review)

Table 1. Overview of Grouping Entity Types and Relationship Types

Type	Name	Definition	Domain and Range
Grouping entity	Series	A set of related video games, often indicated by consecutive numbering, continuing narrative, or similarities in gameplay and themes.	-
	Franchise	A commonly used name that refers to the intellectual property, related data, and content shared among a group of cultural objects.	-
	Universe	An intellectual and/or creative domain represented by the recurrent ideas, themes, and/or settings from multiple video games or game series.	-
	Collection	An anthology of local releases of video games grouped and published together.	-
Relationship type	isPortOf	A video game that is converted to run on a different platform than the one it was originally designed for.	Edition
	isRemakeOf	A video game that is a re-released version of the original game with enhanced features with regard to graphics, stories, gameplay, etc.	Game
	isRebootOf	An attempt to restart an existing video game series or franchise with a new story line disregarding what was established before.	Series, Franchise
	isPrequelOf	A video game that occurs sequentially before another game based on its narrative.	Game
	isSequelOf	A video game that continues the narrative of an earlier game.	Game
	isSidestoryOf	A video game that presents a story from an existing game from a different perspective that is orthogonal or parallel.	Game
	isSpinoffOf	A video game featuring one or more characters or character archetypes from the original game or series.	Game, Series
	isCrossoverOf	A video game in which characters from two of more games, series, franchises, or universes appear together.	Game, Series, Franchise, Universe
	isSpiritual SuccessorOf	A video game designed to be similar to existing game while distinguishing itself as a separate IP (intellectual property), often created by the same individual(s).	Game, Series
	isInspiredBy	A video game designed as a result of intellectual and/or commercial influences from an existing game.	Game, Series, Franchise, Universe
	complements	An additional content that modifies, replaces, or adds gameplay features of a particular video game.	Additional content, Local release

The subsequent 11 rows describe relationship types that can be used to connect video games. For each relationship type we also determined its domain and range —i.e., the subject of the relationship and its objects— in accordance with the entity types identified in the conceptual modeling work. Detailed discussion on each relationship follows.

Discussion

Series

In the UW/SIMM Metadata Schema for Video Games, series is defined as "a set of related games, often indicated by consecutive numbering, continuing narrative, or similarities in game play and themes, to which the game being described belongs" (Lee, Perti, & Clarke, 2014, p. 2). The *Final Fantasy VII* series, whose members include *Final Fantasy VII*, *Before Crisis: Final Fantasy VII*, *Dirge of Cerberus: Final Fantasy VII*, and others, is an example of a video game series. Series information is deemed highly useful by gamers, ranking as the 4th most useful element after price, platform, and genre (Lee, Clarke, & Perti, under review).

Determining series information can be difficult because series can be established based on any one of many criteria. For instance, some series are established based on consecutive numbering (e.g., *Shin Megami Tensei Persona 1* through *4*), whereas other series do not use numbering to connect video games (e.g., *Katamari Damacy, We Love Katamari, Katamari Forever, Beautiful Katamari*). Some series use numbering in some titles while other members of the same series have unnumbered titles (e.g., the *God of War* series consists of *God of War I, II, III,* and *Ascension*, a prequel to the trilogy).

Some video games constitute a series because there is a continuation of the same story across multiple games (e.g., *Halo* series). Other video games not connected story-wise can make up a series based on a similar theme, setting, and/or gameplay format (e.g., *Tales of Symphonia, Tales of Graces F*). For some series, video games within the series evidence both continuous and discrete narrative blocks. The *Kingdom Hearts* series is an example where many of the games feature a continuous narrative block but *Kingdom Hearts Mobile* features a discrete narrative even though it includes several of the original game's main characters.

To further complicate matters, some games belong to multiple series: for example, *Shin Megami Tensei: Persona 4* belongs to the *Shin Megami Tensei* series, the *Persona* series (sub-series of *Shin Megami Tensei* series), and the *Persona 4* series (sub-series of *Persona* series and sub-sub-series of *Shin Megami Tensei* series). The *Tales* games also have various titles belonging to the main series (e.g., *Tales of Symphonia, Tales of the Abyss, Tales of Vesperia*) as well as the spinoff series (e.g., *Tales of the Tempest, Tales of VS.*). The concept of spinoff series is further discussed in a later section.

Considering these different examples of series, it may be useful to specify why a particular game belongs to a series. Sequential numbering of titles, similar and/or the same narrative, characters, spatial setting, timeline, and gameplay are the primary reasons identified so far.

Franchise

Franchise is defined in the UW/SIMM schema as "a commonly used name that refers to the intellectual property, related data, and content shared among a group of cultural objects to which the game being described belongs (Lee et al., 2014)." *Final Fantasy* or *Pokémon* are examples of franchises whose members span not just video games but also films, comics, novels, and music.

Universe

The Universe entity is a broad aggregation of individual video game characteristics that form a collective context. This is a similar construction to the popular Marvel® Comics Universe (MCU). The MCU aggregates the settings of Marvel's many comic book titles and series (e.g., *The Avengers*, *Captain America*, *The Incredible Hulk*, *Iron Man*, etc.) into a single context that provides the basis through which various Marvel comic books relate to one another.

An example of universe within the video game realm is the *Final Fantasy* universe. The *Final Fantasy* universe encompasses multiple series and video games, including the main sequence series (i.e., *Final Fantasy [I]* up to *Final Fantasy XV*), sub-series (e.g., *Final Fantasy XIII*, *Final Fantasy XIII 2*, and *Lightning Returns: Final Fantasy XIII*), spin-off series (e.g., *Crystal Chronicles* series), spin-off games (e.g., *Chocobo Racing*), spiritual successors (e.g., *Mana* series), and crossovers (e.g., *Dissidia* series). All of these games feature recurrent themes such as crystals, life force, and apocalypse, as well as character archetypes and species, therefore sharing a contextual framework through which users and developers intellectually understand them. The concept of universe is broader than franchise as it also includes spiritual successors; for example, *Mana* series would be considered as part of the *Final Fantasy* universe but not the *Final Fantasy* franchise.

Collection (Anthology)

As a literary term, anthology is defined as "a collection of poems or other short writings chosen from various authors, usually as favourite pieces exhibiting the best of their kind (Baldick, 2008)." While this conceptual definition of anthology is amenable to video game releases, we choose to use the label "Collection" due to user familiarity and game self-description. Examples of game collections include *Kirby's Dream Collection* containing six previous Kirby titles, and *Blizzard's Game of the Year Collection* containing *Diablo, StarCraft,* and *Warcraft II: Tides of Darkness*.

Port (isPortOf)

Originating from software engineering, porting refers to "moving a system across environment or platforms" (Frakes & Fox, 1995). In the video game domain, the term refers to "the process of converting the code and assets designed for one platform over to another platform" (Carreker, 2012). When a game is ported, it is meant to "run natively on the new platform and use its technological capabilities accordingly," which is different from emulation "whose goal is to enable one platform to function as another with assistance of hardware and/or software" (Giantbomb, n.d.). The term "port" is broadly used to refer to game editions that are true ports as well as enhanced/reworked versions of a previous game edition. Sometimes the term "re-release" is used to either refer to a port or a remake (see following sub-section).

Tetris, available on more than 65 different computer game platforms, is credited as the most ported computer game in the world.[2] Another example is *Doom* for the PC (1993) which was ported to Super NES (1995), PlayStation (1995), and Xbox 360 (2006), among others.[3] This relationship is modeled as a relationship type "isPortOf" with instances of the "Edition" entity type as domain and range.

Remake (isRemakeOf)

The term "Remake" was imported from movie journalism and the movie business (Braudy, 1998). In movies, the term refers to "a motion picture made from a film story which has been produced earlier" (Beaver, 2007, p. 204). Beaver notes that movie remakes may use the same or different titles, and may follow the same plot as the original or update plots, themes and settings to reflect the contemporary milieu. The most apparent motivation behind remakes is economic, but there is also a general intuition that the "same underlying fable" is compelling to the audience (Braudy, 1998).

Horton and McDougal (1998) question the boundaries of remake, and specifically mention crossovers into other forms of media: "At what point does similarity become simply a question of influence? And what is the difference between a remake and the current television label 'spin-off'?" We distinguish spin-off games (described below) from remakes based on a lack of connection between the new and original game regarding the story, theme or gameplay format. Remake is also different from reboot based on scope (see Reboot, below).

In the video game domain, the term "remake" is sometimes used interchangeably with "port" to refer to a new release of a previously existing game. The confusion stems from some cases where a game may be a port and also a remake of an existing game. The distinguishing factor is that a port

is created to run the game on a different platform whereas a remake indicates that some aspect(s) of the original game was altered or updated (e.g., with better graphics/music, additional gameplay features or stories) but, it does not indicate that the remake will necessarily run on a different platform. Some exceptional examples are challenging to classify as a remake, such as when an extremely popular video game is recreated by fans through the use of open world platforms (e.g., the *Minecraft* remake of *Castlevania*). This relationship is modeled as a relationship type "isRemakeOf" with instances of the "Game" entity as domain and range.

Reboot (isRebootOf)

The term "reboot" originates from computing as a process of restarting the computer, but in the video game domain, it refers to restarting a franchise or series "from scratch and discounting all that's gone before" rather than making a new sequel or prequel (Parfitt, 2009). Willits (2009) offers a similar definition of reboot: "to restart an entertainment universe that has already been previously established, and begin with a new story line and/or timeline that disregards the original writer's previously established history, thus making it obsolete and void." The disconnection from the previous series and the point of starting anew seem to be the key components of rebooting.

As reboot is also a new adaptation and interpretation of a game, it may be confused with remake. The main differences between reboot and remake are 1) reboot typically applies to series or franchise (not a single game), and 2) reboot generally involves a greater departure from the original series in terms of story, graphic, gameplay, etc.

Rebooting a series in other media such as comic books is frequently done in an attempt to revitalize existing series, giving "the new artists the creative freedom to take the story in a different direction (Swenson, 2011)." Examples of rebooted video game series include the *Prince of Persia* original trilogy which was rebooted as *The Sands of Time* series. The original *Castlevania* series was also rebooted as *Castlevania: Lords of Shadow* series. This relationship is modeled as a relationship type "isRebootOf" with instances of the "Series" and "Franchise" entity types as domain and range. Nevertheless, the relationship can be instantiated at the Game level to signify that a reboot must start with a new single game that eventually might evolve into a new series.

Prequel and Sequel (isPrequelOf, isSequelOf)

Time-based relationships occur in nearly every existing narrative media. The two most common time-based narrative relationships are prequels and sequels. Sequels are works that continue the story or theme of an earlier work,[4] while prequels "focus on the action that took place *before* the actual narrative" (Silverblatt, 2007, p. 211). Sequential

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[2] http://www.guinnessworldrecords.com/records-3000/most-ported-computer-game/

[3] http://www.allgame.com/game.php?id=776

[4] https://www.oxforddictionaries.com/definition/english/sequel

ordering must be indicated to make a game either a prequel or sequel of the existing game. Sequencing refers to the fictional time of the narrative, not the time of a game's publication, as prequels can be published after their sequel. A prequel, just as sequel, assumes that the audience is familiar with the original work (Silverblatt, 2007). The *Kingdom Hearts (KH)* series contains examples of prequels and sequels. The narrative timeline of the games is as follows:

- *KH Birth by Sleep* (2010)
- *KH* (2002)
- *KH: Chain of Memories* (2004) and *KH 358/2 Days* (2009)
- *KH II* (2006)
- *KH coded* (2011)
- *KH 3D: Dream Drop Distance* (2012)

KH Birth by Sleep is a prequel set 10 years before the original game *KH* although it was published eight years after the original game. *KH: Chain of Memories* is a sequel of *KH*. The relationships described here are modeled as the inverse relationship types "isPrequelOf" and "isSequelOf", with instances of the "Game" entity type as domain and range.

Side story (isSidestoryOf)

Side story games expand the narrative of existing game(s) by providing an additional story from a different perspective, either orthogonal or parallel. *KH 358/2 Day*s and *KH: Chain of Memories* from the above example are both side stories providing additional narratives to the main games in the *KH* series. The timelines of the two side stories overlap, as *KH 358/2 Days* cuts across *KH, KH: Chains of Memories,* and *KH II. KH: Chains of Memories* tells the story of the main series protagonist, while *KH 358/2 Days* focuses on the story of a different character closely related to the main protagonist. The defining feature of a side story that distinguishes it from sequel or prequel is the overlap of the timeline with the main narrative of an existing game. This relationship is modeled as a relationship types "isSideStoryOf" with instances of the "Game" entity type as domain and range.

Spin-off (isSpinoffOf)

The term "spin-off" generally refers to "a by-product or incidental result of a larger project."[5] Spin-off games feature one or more characters, character archetypes, or particular species from the original game or series. An example is *Chocobo Racing* which features the "chocobo" species from the *Final Fantasy* series. The new game is not necessarily connected directly with the story, theme, or general gameplay of the original series. The difference between spin-off and side story is that spin-off games imply a stronger divergence from the main narrative than side story games. In the *Kingdom Hearts* series, three games are

spin-offs*: KH V Cast, KH Mobile,* and *Kingdom Hearts X.*[6] These three games feature the same characters from the *KH* series, but the plots have no connection to the main narrative of the series and thus are considered non-canonical. This relationship is modeled as a relationship types "isSpinOffOf" with instances of the "Game" or "Series" entity as domain and range.

Crossover (isCrossoverOf)

Carreker (2012) provides two definitions for the term "crossover": "1) an appearance of a character from one title in another character's publication," and 2) "the negotiated and legal appearance of one company's IP [intellectual property] in another company's product" (p.55). Crossovers can be based on a legal agreement between the corporate bodies responsible for publications involved, but also done by fans without legal authorization. The term "crossover" is used for multiple media in addition to video games, including novels, films, TV shows, comic books, etc. Crossovers have existed since late 1970s as a subgenre of fan fiction in which "Characters from two or more different media sources are brought together in a single story" (Turk, 2011), and possibly earlier for comics.

Examples of crossover games include *Kingdom Hearts,* a crossover between the *Final Fantasy* series and the Disney franchise featuring characters from both worlds; *Super Smash Bros. for Nintendo 3DS and Wii U* is a crossover featuring characters from a number of Nintendo game series including *Super Mario Bros., Pokémon, Kirby, Legend of Zelda, Mega Man, Metroid,* etc.; and *Professor Layton vs. Phoenix Wright: Ace Attorney* is a crossover between the *Professor Layton* series and the *Ace Attorney* series. This relationship is modeled as a relationship types "isCrossoverOf" with instances of the "Game", "Series", "Franchise", or "Universe" entity types as domain and range.

Spiritual successor (isSpritualSuccessorOf)

"Spiritual successor" is defined as "a game designed to be very similar to a previously released game while distinguishing itself as a separate IP, often made by many of the same team members who worked on the earlier game" (Carreker, 2012, p. 206). The involvement of licensing issues in the creation of spiritual successors is emphasized in other definitions as well: "when a developer creates a game that could be perceived as a new installment in an existing franchise that they have worked on before but does not share the same name due to licensing issues or other reasons, [it] is called a spiritual successor…This does not include games that are simply similar to other games" (Giantbomb, 2014). The title of the spiritual successor must be different from the original game due to licensing issues.

As it is created by the same developer(s) as the original game, a spiritual successor naturally tends to share many

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[5] http://www.oxforddictionaries.com/definition/english/spin -off

[6] http://www.khwiki.com/Kingdom_Hearts_(series)

elements of the original game such as themes and/or game mechanics. The continuation of narrative may or may not occur, but such continuity is not necessary to characterize a spiritual successor. For example, *Dark Souls* is a spiritual successor of *Demon's Souls*. Both games are developed by the same team (From Software) with a common dark fantasy theme. Both games feature soul-eating demons, similar artistic style, and similar gameplay (action RPGs known for their difficulty). Sony Corporation owns the IP to *Demon's Souls*, and thus the developers created a spiritual successor *Dark Souls* in order to release the game for Microsoft Xbox 360.[7] Another example is *Shadow of the Colossus,* a spiritual successor to *ICO*. They were both developed by Team ICO and directed by Fumi Toueda. Both games share common themes such as shadowy figures, horned characters, and fictional languages.[8] *Portal* is officially stated as a spiritual successor of *Narbacular Drop*; Kim Swift created *Narbacular Drop* as a student at DigiPen and was later hired by Valve to complete *Portal*.[9] This relationship is modeled as a relationship types "isSpirtualSuccessorOf" with instances of the "Game" or "Series" entity types as domain and range.

Inspiration (isInspiredBy)

The "isInspiredBy" relationship is designed to capture influences that propagate from one game to another due to artistic, commercial, or intellectual influence. A game inspired by another game must be a completely distinct game and thus not share any sequel/prequel or side story types of relationships. A game inspired by another may also be its spiritual successor, but this relationship is not mandatory. The primary goal is to capture relationships between games that are similar to a spiritual successor but lack the requirements for the explicit spiritual successor relationship.

One example is *Castlevania: Symphony of the Night*, a game inspired by *Metroid* and a sequel to the original *Castlevania.* The original *Castlevania* was a linear side-scrolling platformer that only allowed players to advance progressively from level to level. Once they had completed a level, they could not go back and replay it without starting a new game. *Metroid* was also a side-scrolling platformer. Unlike *Castlevania*, *Metroid* allowed players to freely move back across previously completed levels. Many of the early games in the *Castlevania* series, with the notable exception of *Castlevania II: Simon's Quest*, were linear side-scrolling games. With the advent of *Castlvania: Symphony of the Night*, which incorporated the free-roaming mechanic from *Metroid*, a new kind of *Castlevania* game emerged. So many of the subsequent additions to the *Castlevania* franchise used *Metroid*'s free-roaming mechanic that users

felt licensed to coin a new genre term, "Metroidvania," to describe them. Through use of the "isInspiredBy" relationship, we can explicitly link examples such as *Castlevania: Symphony of the Night* to older games that have heavily influenced their design, i.e., *Metroid*.

This relationship may also be used to represent imitations of existing games. Imitations are especially prevalent among digitally distributed games such as game apps. Figure 2 shows examples of various imitations of the game app *Flappy Bird,* such as *Flappy Penguin, Flappy Troll,* and *Floppy Bird*. This relationship is modeled as a relationship types "isInspiredBy" with instances of the "Game", "Series", "Franchise", or "Universe" entity types as domain and range.
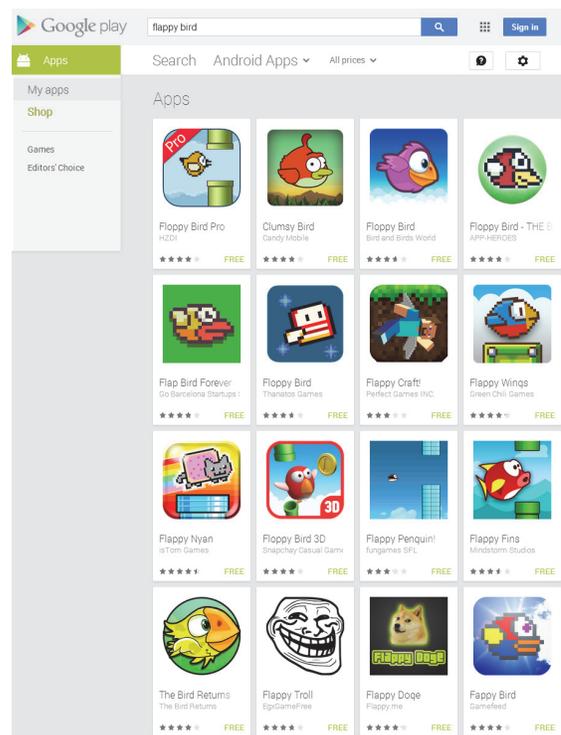

Figure 2. Imitations of *Flappy Bird*

Expansion (complements)

The term "expansion" refers to additional content that modifies, replaces, or adds gameplay features (Lee et al., 2014). Carreker (2012) also defines expansion as "a sequel to a game, often limited in scope that requires the installation of the original game to function" (p. 78). The relationship between some additional content and a video game is modeled as a relationship type "complements" with instances of the "Additional Content" entity type as domain and instances of "Local release" the entity type as range.

One example is *Dynasty Warriors Xtreme Legends*. *Xtreme Legends* is a series of expansions written specifically for the *Dynasty Warriors* series of video games. These expansions are published through discs that players must purchase separately from the original game. While players can play a small amount of game content from the *Xtreme Legends*

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[7] http://www.gameinformer.com/b/news/archive/2012/02/10/shuhei-yoshida-interview.aspx

[8] http://en.wikipedia.org/wiki/Shadow_of_the_Colossus

[9] http://www.gamasutra.com/php-bin/news_index.php?story=160

disc alone, they must load data from the pertinent *Dynasty Warriors* game disc to actually experience the full range of additional features. Starting with *Dynasty Warriors 3*, Tecmo Koei has published an *Xtreme Legends* expansion for each subsequent entry in the *Dynasty Warriors* series. Another example of an expansion is the *Gods & Kings* expansion for *Civilization V*. While the expansion is available through a variety of media, players must have the basic *Civilization V* game to experience the new content.

Crosswalk of relationships
Based on our investigation of existing standards in conjunction with the preceding definitions of relationships predominant in video games, we provide the following crosswalk table (Table 2). This table shows the relationships identified in the video game domain with the equivalent (or most similar) relationships found in other models and standards. All 15 defined video game entities and relationships can possibly be mapped to some type of relationship in at least one existing standard, and in most cases, multiple standards. However, a significant issue in these mappings is the loss of specificity. The relationships in extant standards are often much broader than the nuanced definitions of relationships needed in the video game domain. Use of existing standards to represent these relationships will result in information loss since their definitions are not specific enough to capture the distinctions expressed in our proposed set of relationships. For example, "relation" in DC can be mapped to 7 different proposed relationships for video games, but is not granular enough to express the differences. DC does allow the use of qualifiers, which might be used to express the desired nuances between different applications of "relation." Yet with qualifiers, a risk of overgeneralization still occurs through DC's dumb-down principle.[10] Eleven relationships identified among video games map to the equally broad concept of "Related Works" in CCO. CCO offers examples of more nuanced related works, such as "Associative," "Hierarchical," and "Link," but these are only provided as examples and not explicitly modeled.

Issues of scope and objectives of the existing standards also affect the usefulness of the mappings. Despite CIDOC CRM's established scope of museum collections and the objective of describing such collections and their related contexts, there are relatively few ways to describe video games well. CIDOC CRM emphasizes entities such as physical artifacts, events, activities, and geographic locations, and has strict limitations on which properties and relationships can be applied to which entities. For example, "P46 is composed of (forms part of)" superficially seems like a useful mapping for games that form a part of a series. However, CIDOC CRM limits the domain and range for this property to strictly physical components. While this

may apply to description of a video game at the level of an individual instantiation, it cannot be used to describe a more abstract concept of "game" as is currently modeled, nor could it apply to games with no existing physical components, such as digitally distributed games like downloadable apps or streaming games. Likewise, the CIDOC CRM properties mapped to temporal and influence relationships are limited to activity and event entities. For example, to accurately map CIDOC CRM to isPrequelOf, isSequelOf, and isSideStoryOf, we would need to describe the *events within a game* as occurring before or after events within another game, rather than describing the games themselves. This may appear to be a subtle difference, but it is with significant repercussions in crosswalking.

Additionally, as with all crosswalks, there are instances where no relevant elements or properties exist in other schemas. For example, there were no equivalent relationship types for series, franchise, and universe in CIDOC CRM. FRBR, surprisingly, has a property describing sequels, but no explicit reciprocal property or additional relationship to describe a prequel. Almost none of the existing standards included an adequate mapping for the video game concept of "universe," possibly because parallel concepts are not considered relevant in the other domains these standards were designed to describe.

CONCLUSION AND FUTURE WORK
Video games and other interactive media are unique cultural heritage artifacts that often combine elements from a variety of domains. Traditional bibliographic and cultural heritage domains offer standards and models attempting to describe relevant artifacts and the relationships among them. However, due to their unique design and possible interpretations by various users, video games do not always fit existing models. In this paper, we defined commonly occurring relationships among a variety of video game formats and genres and grouping entities that emerge from the instantiation of these relationship. We also attempted to align them, where possible, with relationships exiting in other schemas. Where no extant relationship was found, we suggested new relationships intended for use in data modeling specifically for the video game domain. Many of these relationships may also applicable to other domains including literature, TV shows, films, comics/graphic novels, etc. The new understanding of relationships, opportunities for interoperability and new property definitions presented here will be added to our ongoing work developing a data model, metadata schema and controlled vocabularies specifically for video games and interactive media.

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[10] http://wiki.dublincore.org/index.php/Glossary/Dumb-Down_ Principle

Table 2. Crosswalk of Relationships across Standards

Our Model	Dublin Core	FRBR	RDA	CIDOC CRM	CCO
Series	hasPart/isPartOf	Whole/Part Series Statement	in series/ series contains subseries of/subseries	P46 is composed of (forms part of)	Series Whole-Part
Franchise	hasPart/isPartOf	Aggregate Work Entity	contains/ contained in	P46 is composed of (forms part of)	Whole-Part
Universe		Aggregate Work Entity			
Collection	Collection	Aggregate Work Entity	contains/ contained in	E78 Collection	Group/Collection
isPortOf	hasVersion/ isVersionOf	Reproduction Alternate	reproduced as/ reproduction of		Related Works
isRemakeOf	hasVersion/ isVersionOf	Reproduction Adaptation Revision	based on/derivative work (broader) - adaptation of/ adapted as - expanded version of/expanded as - remake of/ remade as - revision of/ revised as		Related Works
isRebootOf	hasVersion/ isVersionOf	Adaptation Alternate Arrangement Reconfiguration	revision of/ revised as		Related Works
isExpansionOf	requires/ isRequiredBy	Complement Supplement	complemented by/complement of supplement to/ supplement	P110 augmented (was augmented by)	Related Works
isPrequelOf	Relation		prequel to/prequel	P120 occurs before (occurs after)	Related Works
isSequelOf	Relation	Successor	sequel to/sequel	P120 occurs before (occurs after)	Related Works
isSidestoryOf	Relation	Complement Related Endeavor[11]	based on/ derivative work complemented by/complement of	P118 overlaps in time with (is overlapped in time by)	Related Works
isSpinoffOf	Relation	Related Endeavor	based on/ derivative work	P15 was influenced by (influenced)	Related Works
isCrossoverOf	Relation	Related Endeavor	based on/ derivative work(s)	P15 was influenced by (influenced)	Related Works
isSpiritualSuccessor Of	Relation	Adaptation Imitation	adaptation of/ adapted as imitation of/ imitated as	P15 was influenced by (influenced)	Related Works
isInspiredBy	Relation	Imitation	imitation of/ imitated as	P15 was influenced by (influenced)	Related Works

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[11] http://vocab.org/frbr/core.html#Endeavour

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