Universidad Rey Juan Carlos

TESIS DOCTORAL

Diseño e implantación de un modelo de análisis socioeconómico y gestión sostenible para los sistemas mesoeconómicos

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Introducción y motivación al tema de estudio

Resumen

Esta investigación pretende diseñar y validar un nuevo modelo de análisis para el estudio de sistemas socioeconómicos complejos, como son el sector del Patrimonio Cultural y los distritos industriales. Desde una perspectiva económica y empresarial sostenible, el estudio se propone ofrecer una herramienta para entender, interpretar y aplicar buenas prácticas para su gestión y valorización.

Abstract

This research intends to design and validate a new model of analysis for the study of complex socio-economic systems, such as the Cultural Heritage sector and industrial districts. In a sustainable economic and business perspective, the study aims to provide a tool for understanding, interpreting and applying best practices for their management and valorization.

Riassunto

Questa ricerca è volta alla progettazione e validazione di un nuovo modello di analisi per lo studio di sistemi socioeconomici complessi, quali il settore dei Beni Culturali e i distretti industriali. In una prospettiva economica e aziendale sostenibile, lo studio si propone quindi di fornire uno strumento per comprendere, interpretare e applicare le buone pratiche per la loro gestione e valorizzazione.

Elementos relevantes

El nuevo modelo se basa en el paradigma interpretativo hermenéutico y utilizará la lógica abductiva para integrar en un único protocolo operacionales de Life Cycle Sustainability Assessmen (LCSA), las herramientas del enfoque del ciclo de vida: Life Cycle Assessment (LCA), Life Cycle Costing (LCC) y Social Life Cycle Assessment (S-LCA), abordando las temáticas de sostenibilidad medioambiental, económica y

social. Con ello se pretender hacer posible el análisis y gestión de sectores como éste, con complejas y numerosas interrelaciones entre sus agentes económicos donde tanto su falta de identificación como de una adecuada integración de los portadores de intereses, constituyen una gran oportunidad perdida.

	ÁMBITO	SECTOR	SUBSECTOR
SECTORES CULTURALES	CAMPO DEL ARTE	**Artes visuales**	artesanía pinturas escultura fotografía
		Artes escénicas	teatro danza circo festivales
		Patrimonio Cultural	arquitecturas históricas museos sitios arqueológicos bibliotecas archivos
	INDUSTRIASCULTURALES	**Cine y Video** **Televisión y radio** **Videojuegos** **Música** **Libros y prensa**	
SECTORES CREATIVOS	INDUSTRIAS Y ACTIVIDADES CREATIVAS	**Diseño** **Arquitectura** **Construcción**	moda diseño gráfico diseño de interiores diseño del producto **industria cerámica** muebles de baño
	INDUSTRIAS RELACIONADAS	**Publicidad** **Industria informática** **Telefonía** **Internet**	

Tabla 1: sectores culturales y creativos (Fuente: elaboración propia basándose en "*The economy of culture in Europe*", Informe Jan Figel, 2006).

A este respecto podemos considerar el sector del Patrimonio Cultural como un subsector, muy especializado, del más amplio sector de las construcciones al cual pertenece también el sector de la industria cerámica azulejera, en cual se intentará validar el mismo modelo de análisis. De esta forma podemos encontrar una relación

entre los dos sectores: Patrimonio Cultural e Industria Cerámica, a este respecto cabe destacar que la Comisión Europea ha adoptado recientemente una clasificación para evaluar el valor económico generado por la cultura. La Comisión distingue entre los campos culturales (incluyendo las artes el patrimonio y las industrias culturales, es decir, los sectores de la producción, distribución y venta de contenidos) y los sectores creativos, reconociendo a los primeros "output" de carácter artístico y cultural y a los segundos el uso de estos "output" para la producción, y realización de bienes y servicios que tienen una referencia artística y cultural (Tabla 1). Se puede apreciar como el Patrimonio Cultural sea un sector en el Campo del Arte y la Industria Cerámica, por su contenido estético, un subsector entre las Industrias Creativas. Mas recientemente Casani et al., (2012) han investigado sobre las definiciones de industrias creativas y culturales y la economía de la cultura concluyendo, entre otras cosas, que hoy en día la mayor parte de las industrias tradicionales están incorporando los valores del diseño y la creatividad a sus productos para diferenciarse de la competencia. De esta manera los aspectos intangibles, derivados del pensamiento creativo, han pasado a ser elementos fundamentales de la oferta de los productos y servicios como en el caso de la industria azulejera.

Estado de la cuestión

El Patrimonio Cultural

El Sector del Patrimonio Cultural ha experimentado una gran evolución en los últimos cincuenta años tanto en su terminología como en su desarrollo, que se ha reflejado en una definición más amplia desde sus primeras acepciones reflejadas en la Carta de Venecia de 1964[1] hasta las más actuales. El término “monumento histórico”

[1] Carta Internacional de Venecia de 1964 sobre la conservación y restauración de monumentos históricos

entonces expuesto ha sido reinterpretado por ICOMOS[2] en 1965 como "monumento" y "sitio"; poco después por la UNESCO[3] como "Propiedad Cultural" en 1968; posteriormente la World Heritage Convention en 1972 aúna ambas concepciones hasta extenderse en la actualidad tanto a elementos tangibles como intangibles, así como a espacios culturales y naturales[4] (Yahaya, 2006).

Paralelamente a su evolución conceptual, ha habido una atención creciente en lo referente al Patrimonio Cultural, su conservación y mejora, y no sólo como manera de fortalecer la identidad local, sino también como motor de crecimiento de la economía y del desarrollo social. Por ello, tanto el mundo académico como los responsables políticos han considerado al Patrimonio Cultural como un elemento de posicionamiento diferencial urbano y territorial desarrollando varias teorías y políticas económicas, con el objetivo de un mejor uso del mismo por medio de vincular la dotación y gestión de los recursos culturales con el crecimiento económico de sus lugares (Bowitz et al., 2009).

El Patrimonio Cultural es, por tanto, un bien preciado, tanto en términos sociales como económicos que está adquiriendo cada vez más importancia en el escenario contemporáneo potenciándose, muy especialmente, a partir de los últimos diez años. Así, y según las más recientes estadísticas proporcionadas por la Comisión Europea[5], en el año 2006, este sector aportaba el 2,6 por ciento del PIB de Europa y empleaba a alrededor de 5,8 millones de personas, lo que significa el 3,1 por ciento del empleo total en la "Europa de los 25" (UE-25) suponiendo más del total de población ocupada de países como Grecia e Irlanda juntos en aquellas fechas. Y, es más, se trata de un

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2 ICOMOS (International Council on Monuments and Sites).

3 UNESCO (United Nations Educational, Scientific and Cultural Organization).

4 Sin embargo y pese a este consenso conceptual general entre organizaciones internacionales, a nivel gubernamental de país y a la hora de establecer políticas locales, existe alguna singularidad de términos que añaden cierta complejidad. Como consecuencia, lo largo de este trabajo aparecerán puntualmente otros términos afines junto al de Sector del Patrimonio Cultural, como el de Sector de Bienes Culturales, Industria del Patrimonio Cultural o Sistema Cultural, cuya pluralidad se tratará de evitar salvo cuando se considere necesario (mantener citación original, etc.).

5 KEA - European Statistics 2006, The economy of culture in Europe, disponible en http://ec.europa.eu

sector con gran futuro ya que, en el nuevo siglo, muestra tasas de crecimiento superiores a la media del resto de los sectores en la economía de los países occidentales. Además, según el mismo informe, el empleo en el sector cultural creció cerca de 1,85% mientras que el empleo total en Europa disminuyó en mismo período de 2002-2004. Asimismo, otro estudio similar de Eurostat (2007)[6] confirma también estos hechos. Más recientemente, según un estudio realizado recientemente por la consultora E&Y[7] (2014), el sector de las Industrias Culturales y Creativas (ICC) donde se incluye el Patrimonio Cultural, ha demostrado una extraordinaria resistencia a la crisis económica. Con un volumen de negocio de 535.900 millones de euros y 7,1 millones de puestos de trabajo (el 19,1% de ellos ocupados por trabajadores menores de 30 años), la cultura y las actividades creativas suponen el 3,3% de la población activa de la Unión Europea. El estudio también destaca que entre 2008 y 2012 los puestos de trabajo en la UE disminuyeron (-0,7% por año) mientras que, en el mismo período, los de las industrias culturales y creativas han registrado un aumento de 0,7% por año.

La Economía del Patrimonio Cultural

A pesar de que en la actualidad sea ampliamente aceptado que el sector de bienes culturales contribuye en una parte significativa a los resultados económicos de cualquier país, sigue habiendo dificultades en la evaluación de los efectos positivos que generan las actividades de sus empresas y entidades que conforman la llamada "cadena cultural" así como, el impacto particular de las políticas económicas de las administraciones públicas sobre el crecimiento económico.

En particular, se ha de resaltar la carencia de métodos de investigación capaces de detectar determinados aspectos dinámicos del sistema cultural y de ahí la oportunidad

6 EUROSTAT - European Commission, Cultural Statistics 2007 edition, disponible en http://epp.eurostat.ec.europa.eu/cache/ITY_OFFPUB/KS-77-07-296/EN/KS-77-07-296-EN.PDF

7 E&Y - (Ernst & Young) 2014, Creating Growth: Measuring Cultural and Creative Markets in the EU, disponible en http://www.creatingeurope.eu/

de este trabajo que trata de subsanar esta deficiencia. Como resultado de esta escasez o falta de datos del sector, se da una información que ni es adecuada ni se presenta de forma sistemática sobre los operadores privados de servicios al Patrimonio Cultural y actividades culturales, es decir, sobre las empresas que forman parte del complejo sistema de relaciones que caracterizan a todo el sector (McLoughlin et al., 2006).

Entre las causas principales y primeras de esta deficiencia se encuentra la falta de una definición y delimitación precisa de los grupos de interés que configuran este sector, lo que dificulta la forma de abordar su análisis y estructuración. Igualmente, y una vez supuestamente definidos y delimitados éstos, está el problema del análisis de sus complejas interacciones de cara a su mayor conocimiento y posterior mejor gestión del Patrimonio Cultural.

La ausencia de una delimitación precisa de estos grupos de interés particulares se atribuye parcialmente a la dificultad de conciliar su carácter público, que generalmente caracteriza a los materiales y actividades culturales, con aspectos privados estrechamente relacionados con el mercado, o sea a la actividad empresarial (Aas et al., 2005).

La identificación de los portadores de intereses es básica y debe ser previa a la formulación de políticas económicas y estrategias empresariales eficientes en el ámbito del desarrollo sostenible. Así como también resulta fundamental determinar las interdependencias entre ellos, siendo útil diferenciarlos a distintos niveles entre agentes macro y microeconómicos (Arnaboldi et al., 2011).

Para ello, se va a acudir a la Economía del Patrimonio Cultural que como nueva disciplina estudia este sector teniendo entre sus principales análisis la interacción entre los distintos agentes económicos involucrados en la gestión del Patrimonio y sus bienes calificados como "culturales". En este sentido, existen diversas experiencias

de instituciones públicas y privadas que ya han realizado estudios para medir el avance de la economía del patrimonio cultural en regiones o países específicos, si bien en la mayoría de los casos simplemente se han medido aspectos concretos sin interrelacionarlos correctamente por su dificultad (Cerquetti, M., 2010). Así, muchos de sus resultados están enfocados a aspectos parciales como la adopción de tecnologías (Rogerio-Candelera et al., 2013) y, en algunos casos, a capacidades de innovación para el desarrollo de nuevos productos y tratamientos para la recuperación y conservación de sus elementos como, por ejemplo, las obras de arte. Sin embargo, estos modelos "aislados" no explican la forma de cómo la economía del Patrimonio Cultural se inserta en una región o territorio, ni describen la estructura sectorial o territorial que da origen a las formas de innovación tecnológica y de negocio dentro del mismo.

Así, la nueva Economía del sector del Patrimonio Cultural viene a paliar esta deficiencia y puede considerarse entre los sistemas socioeconómicos complejos que, entendido como "capital cultural[8]", constituye un fenómeno de generación de valor e interviene en la función de producción de una economía, aportando utilidades de carácter tanto complementario como sustitutivo a otros sectores con otras opciones o recursos y, por lo tanto, es susceptible de evaluación y gestión colectiva debido a su significativa contribución al desarrollo económico de una sociedad (Re, 2006). Es precisamente este último objetivo, de contribución al desarrollo económico, uno de los principales a perseguir, cuyo logro se podrá además compatibilizar junto con el otro gran propósito que es el de "preservación" del patrimonio para generaciones venideras (Bowitz et al., 2009).

En un sentido amplio, la noción de Patrimonio Cultural incluye tanto recursos materiales, es decir; los monumentos, la pintura y la escultura, como inmateriales; la

8 Se entiende por capital cultural al conjunto de bienes culturales en su sentido amplio que son susceptibles de evaluación y gestión económica (incluir cita).

historia, los valores, las tradiciones y el idioma (Casani et al., 2012). Se crea así un sistema muy complejo compuesto por un gran número de portadores de intereses con sus propios objetivos, problemas y creencias sobre la manera correcta de gestionar esta variedad de recursos que les afectan. Por lo tanto, se origina un problema relevante en términos de coordinación y gobierno de todos ellos.

Concluyendo, el nuevo campo del desarrollo económico en el ámbito del Patrimonio Cultural o Economía de la Cultura es un espacio en crecimiento que busca revisar modelos básicos, así como construir otros nuevos más complejos para explicar el comportamiento de este. Además, se busca un entendimiento más amplio que incorpore otras disciplinas como la sociología, marketing y matemáticas/estadística para explicar este fenómeno económico, así como una estructuración en distintos niveles (macro, micro y meso) para una mejor comprensión del mismo (Mazzanti, 2002).

Los Distritos Industriales

También los distritos industriales, presentan las mismas características de complejidad del Patrimonio Cultural, al ser redes de empresas que ven principalmente la participación de las pequeñas y medianas firmas, así como de otros agentes sociales y económicos, organizados en comunidades que están bien definidas geográficamente, históricamente y culturalmente (Becattini, 1987).

Se considera un distrito industrial como un área geográfica en la que un producto de la cultura local se convierte en un producto industrial, y alrededor de su producción crecen espontáneamente empresas auxiliares y complementarias que facilitan la producción y la comercialización (Santagata S., 2002). El sistema del distrito industrial hace posible la transformación de las manufacturas industriales en "productos representativos" que se distinguen de otros productos, gracias a sus características únicas que se derivan de una cultura específica que caracteriza a un territorio. Gracias

a la base cultural común para los agentes económicos del distrito, se va creando así una un símbolo unificador, tal como el de la industria de la cerámica de Sassuolo en Italia conocido en todo el mundo, detrás del cual se agrupan todos los productores del distrito (Santagata W., 2002).

La cultura y la historia de un territorio sirven para averiguar cuáles son las características que hacen que aquella producción industrial sea específica y competitiva en comparación con otros productos fabricados sin el mismo Patrimonio Cultural. Por lo tanto, la Economía de la Cultura y del Patrimonio Cultural pueden resultar un innovador enfoque para comprender la evolución y desarrollo de los distritos industriales.

La investigación empírica acerca de los distritos industriales y la reflexión teórica sobre los problemas de organización industrial y de desarrollo han llevado a la definición de los caracteres de fondo del distrito industrial como modelo de organización industrial y de desarrollo socioeconómico de los territorios (Sforzi, 2000). Los distritos industriales desempeñan un papel social y económico relevante en la organización industrial italiana (Sforzi, 2009). En el distrito industrial hay una industria principal localizada, y ésta tiene caracteres de sistema de producción manufacturero no jerarquizado: prevalecen las pequeñas y medianas empresas y su correspondiente especialización manufacturera (Bellandi, 2006).

El primer elemento constitutivo del distrito industrial es la comunidad de personas que viven y trabajan en el distrito, es decir, los trabajadores especializados, los artesanos, los pequeños empresarios de las compañías de fase, así como los directivos y los empresarios de todas las empresas a lo largo de la misma cadena de valor/suministro. También forman parte integrante de la comunidad sus instituciones informales, es decir, valores, actitudes y sobre todo normas implícitas de comportamientos; y las formales, como, por ejemplo, el gobierno local, las asociaciones de categoría, los

sindicatos, los bancos, los centros de formación e investigación, por citar sólo las instituciones más comunes, que en el distrito tienden a estar impregnadas del sentido de pertenencia al lugar, con su estilo de vida y de trabajo (Dei Ottati, 2006).

El segundo elemento constitutivo del distrito industrial es la concentración territorial de las empresas de una industria y de las actividades subsidiarias a ésta, como la producción y reparación de maquinarias utilizadas en el proceso productivo localizado, o también la producción de servicios para las empresas locales. La división del trabajo entre las empresas, típica de la forma del distrito, ha provocado que la dimensión de las unidades productivas individuales sea generalmente modesta, pero, siempre por la misma división del trabajo (vertical, es decir, entre empresas de fases diferentes, y horizontal, es decir, entre las empresas de una misma fase), el número de empresas existente en el distrito tiende a ser elevado, de modo que la dimensión total de su aparato productivo sea generalmente grande (Dei Ottati, 2006).

El hecho característico de estos sistemas industriales ha sido su adscripción a un territorio y sus procesos de internacionalización. A lo largo de las últimas décadas, significó que los productos finales del distrito accedieron a los mercados internacionales, sin embargo, el conjunto de la cadena de valor permanecía anclada en el territorio de origen (Corò y Grandinetti, 1999). Esta fidelidad al territorio no se ha considerado una limitación, sino que por el contrario una estrategia deliberada, ya que en ella residía la ventaja competitiva de estas empresas. No obstante, en estos últimos años, el entorno competitivo está sufriendo una intensa y rápida transformación, especialmente en lo referente a la presencia de nuevos competidores, tecnologías y mercados. Este cambio, que está también afectando a los distritos industriales, provoca que muchas de estas aglomeraciones se vean incapaces de mantener los ritmos de crecimiento que venían experimentando (Alberti, 2006).

Por lo tanto, el distrito industrial es un sistema productivo geográficamente localizado, basado en una intensa división local de actividades entre pequeñas y medianas empresas especializadas en los diferentes procesos de la producción y de la distribución de un sector industrial o una actividad dominante; por ello puede resultar interesante analizar la competitividad del distrito por medio del ciclo de vida del sector que representa.

Unos autores han puesto en relación las diferencias de interacción competitiva de las empresas y la etapa del ciclo de vida del sector en que operan (Bowman y Gatignon, 1995; Robertson et al., 1995). Otros han subrayado cómo el análisis del posicionamiento de los productos comercializados en un mercado se configura como una herramienta útil para diagnosticar su estructura de competencia (De la Fuente y Guillén, 2007).

El enfoque interpretativo

Por tanto, existe una necesidad clara de llevar a cabo estos análisis de las interrelaciones entre los grupos de interés del sector de forma integral comenzando por su correcta delimitación que permitan una mejor comprensión y gestión del Patrimonio Cultural y de los Distritos Industriales, y de ahí la oportunidad de este Proyecto que pretende aportar para ello las bases para una novedosa metodología.

La gestión de estos sistemas socioeconómicos ha de tener en cuenta el entramado de complejas relaciones sociales entre los diferentes portadores de intereses que aumenta su valor cuanto más se reconoce y más se arraiga en la conciencia colectiva de una comunidad.

Por su emplazamiento, estos sistemas se sitúan en el espacio "mesoeconómico"[9] intermedio entre la macroeconomía y microeconomía y su complejo análisis, bajo el

9 Mesoeconomía es un término ampliamente aceptado a nivel económico y científico, aunque no está recogido por la Real Academia de la Lengua Española como tal, aunque sí en sus acepciones separadas de meso (medio) y economía. Véase Dopfer et al., 2004, "Micro-meso-macro". Journal of Evolutionary Economics 14 (3): 263-79.

esquema que se presentará en esta Proyecto requiere de un dinámico y continuo cambio de nivel de observación (subjetos/objetos, partes/todo y texto/ contexto) y requiriendo además de una interpretación "histórica" (puesta en su contexto de tiempo y espacio) por su propia naturaleza. Toda esta complejidad estructural que muestran el Patrimonio Cultural y los Distritos Industriales demanda un método especial de análisis que sea capaz de ello por lo que se propone a tal fin el enfoque Hermenéutico (Prasad, 2002) bajo una lógica Abductiva (Niiniluoto, 1999) y una aplicación de herramientas de Gestión del Ciclo de Vida (Jørgensen, 2010).

La hermenéutica (del griego “hermeneutikós”, interpretación) en términos generales es la pretensión de explicar las relaciones existentes entre un hecho y el contexto en el que acontece (Smythe et al., 2012).

La hermenéutica nace como una forma de analizar los textos sagrados de la Biblia, pero la divulgación que ha tenido lugar en las últimas décadas ha llevado a su incorporación en distintas áreas de investigación como las ciencias sociales y, entre ellas, destacan un reducido número de trabajos referidos a las ciencias económicas y empresariales. En todos estos casos los hechos medioambientales, económicos y sociales, representan los “textos” que el hermeneuta tiene que interpretar. Las pocas aplicaciones del método hermenéutico al Patrimonio Cultural se refieren exclusivamente a la restauración y recuperación de las construcciones históricas. Por eso, la extensión de la hermenéutica a las ciencias económicas y empresariales dentro de este sector resulta interesante, novedosa y prometedora a nivel académico abriendo la puerta a una gestión rentable, eficaz y sostenible. Siendo ésta última la razón principal por la cual se decidió aplicar el enfoque hermenéutico en este Proyecto.

Objetivos de la tesis

Si bien ahora es ampliamente aceptado que el sector del Patrimonio Cultural contribuye en buena parte a los resultados económicos de cualquier país en general y de los europeos en particular, por su riqueza de su patrimonio histórico y artístico, sigue habiendo dificultades en la evaluación de los efectos sobre el sistema económico complejo generado por todos los actores que conforman la "cadena cultural", entendiendo por ésta a la cadena de valor aplicada al Sector del Patrimonio Cultural (Golinelli et al., 2015) así como de una adecuada gestión integrada de todos sus elementos. En esta línea también se anunció que, en el origen de esta deficiencia está la ausencia de una definición-identificación precisa de los grupos de interés particulares que se atribuye parcialmente a la dificultad de conciliar su carácter público, que generalmente caracteriza a los materiales y actividades culturales, con temas estrechamente relacionados con el mercado, o sea a las actividades empresariales.

De forma similar, los distritos industriales muestran dificultades al elegir una perspectiva de análisis económica (Sforzi y Boix, 2015). Esta afirmación se sustenta con la conceptualización dual del Distrito Industrial: primero, como unidad de análisis de la investigación económica (Becattini, 1979) y después, como una forma de industrialización (Becattini, 1989).

Con estos antecedentes, los objetivos generales de esta tesis son los siguientes:

I. Diseñar a nivel “mesoeconómico” un modelo de análisis de los sistemas socioeconómicos complejos basado en la hermenéutica y en la lógica abductiva, que tenga en cuenta, al mismo tiempo, de todas las expectativas de la pluralidad de los portadores de intereses.

II. Desarrollar un protocolo operacional para la restauración, conservación y gestión del Patrimonio Cultural basado en criterios de sostenibilidad medioambiental, económica y social por la necesidad de "preservar" el legado histórico que sea capaz de aportar un mayor grado de predicción en la toma de decisiones.

III. Desarrollar un protocolo operacional para la producción industrial de distintas empresas integradas en la misma cadena de suministro/valor, como en los distritos industriales europeos basado en criterios de sostenibilidad medioambiental, económica y social, con el fin de aumentar las ventajas competitivas respectos a los productores de los países emergentes.

Para lograr los objetivos generales la investigación se desarrollará en las siguientes líneas específicas:

- ✓ Construir un marco de antecedentes, conceptual y teórico, con el propósito de dar al proyecto de investigación un sistema coordinado y coherente de conceptos y proposiciones, que permitan abordar el sector del patrimonio cultural y los distritos industriales como ejemplo representativo entre los sistemas socioeconómicos complejos.
- ✓ Esquematizar un nuevo "*Paradigma Hermenéutico Interpretativo*" que pueda proporcionar detalles de información estructural no identificada a otros niveles de análisis como el micro y el macro respecto a la economía de un sector complejo.
- ✓ Diseñar a nivel conceptual un "*Modelo de Gestión: de Cultural Heritage Life Cycle Management (CH-LCM)"* para el Patrimonio Cultural que, dentro de un marco del desarrollo sostenible, permita una lectura y análisis de las

interdependencias entre los portadores de intereses del sector, respecto a su contexto socioeconómico.

- ✓ Poner a prueba a nivel empírico el "*Modelo de Gestión: CH-LCM"* en un caso concreto de proyecto de restauración, promoción y fomento del Patrimonio Cultural como es el de la Fortaleza de la villa de Uncastillo en la provincia española de Zaragoza.
- ✓ Diseñar a nivel conceptual un "*Modelo de Gestión: Industrial District Life Cycle Management (ID-LCM)"* para los Districtos Industriales que, dentro de un marco del desarrollo sostenible, permita una lectura y análisis de las interdependencias entre los portadores de intereses del sector, respecto a su contexto socioeconómico.
- ✓ Poner a prueba a nivel empírico el "Modelo de Gestión: ID-LCM" en un caso concreto de diseño y fabricación de baldosas cerámicas como es el caso del distrito industrial de Sassuolo en la provincia italiana de Módena.

Metodología de investigación

El método por seguir se fundamenta tanto en la investigación conceptual de carácter exploratorio para aclarar y definir la naturaleza del problema, basándose en fuentes de información documentales recogidas, como empírica de datos obtenidos en análisis estudios de casos específicos con el fin de validar el protocolo de gestión del Patrimonio Cultural. Para lograr este propósito, esta investigación se basa en el marco de la Evaluación de la Sostenibilidad del Ciclo de Vida (LCSA, Life Cycle Sustainability Assessment) que incorpora las tres dimensiones de la sostenibilidad con las herramientas de Evaluación del Ciclo de Vida (LCA, Life Cycle Assessment), Costeo del Ciclo de Vida (LCC, Life Cycle Costing) y Evaluación del Ciclo de Vida Social (S-LCA, Social Life Cycle Assessment).

Desarrollo de la investigación

Esta tesis fue realizada en colaboración con el Departamento de Marketing de la Universidad Pontificia Comillas de Madrid y el Departamento de Ciencia y Métodos para la Ingeniería de la Universidad de Módena y Reggio Emilia en Italia. Las actividades de investigación se efectuaron tanto en Italia como en España con el fin de obtener una mención internacional. La investigación condujo a la publicación de tres artículos en revistas científicas internacionales y otros tres que han pasado el escrutinio del editor en otras tres revistas científicas. Además, parte de los resultados se presentaron en congresos internacionales y finalmente, en el marco del doctorado, se presentó un proyecto de investigación financiado por la Comisión Europea en el marco del Programa LIFE.

Publicaciones en Revistas Indexadas

Settembre Blundo, D., García Muiña, F. E., Fernández del Hoyo, A. P., Riccardi, M. P., & Maramotti Politi, A. L. (2017). Sponsorship and patronage and beyond: PPP as an innovative practice in the management of cultural heritage. *Journal of Cultural Heritage Management and Sustainable Development*,7(2), 147-163.

ÍNDICES DE CALIDAD (2017): SCOPUS: SJR (2017): 0,26, Q1.

En este artículo se presentan métodos de gestión alternativos para el sector del Patrimonio Cultural, además del modelo tradicional de apoyo público. Estas alternativas se basan en el patrocinio y el mecenazgo, así como en la nueva y más innovadora colaboración público-privada (PPP). En el documento se destaca que el patrocinio, el mecenazgo y la colaboración público-privada no son sólo formas alternativas de obtener financiación pública para el sector del Patrimonio Cultural, sino

que también son nuevas prácticas de gestión estratégica que, si se llevan a cabo correctamente, no sólo preservarán y mejorarán el sector, sino que también permitirán que se distribuya más valor entre todos los stakeholders.

Khorassani, S. M., Ferrari, A. M., Pini, M., Settembre Blundo, D., García-Muiña, F. E., & García, J. F. (2018). Environmental and social impact assessment of cultural heritage restoration and its application to the Uncastillo Fortress. *International Journal of Life Cycle Assessment*, 1-22. ÍNDICES DE CALIDAD (2017): Journal Citation Reports: 4,195, Q1; SCOPUS: SJR: 1,268, Q1

La restauración del Patrimonio Cultural, como en otros espacios mesoeconómicos, requiere un enfoque innovador para integrar los principios de sostenibilidad en los procesos. Para ello, en este trabajo se han ensayado metodologías de ciclo de vida para la evaluación del impacto ambiental y social en el caso de una restauración gestionada por una PPP: la Fundación Uncastillo en la provincia aragonesa de Zaragoza. Se realizó un análisis de LCA ambiental en el estudio de caso, evaluando los efectos de una intervención en un sitio histórico que fue restaurado para convertirse en museo. Los efectos sociales derivados de la intervención fueron examinados y evaluados con un enfoque basado en los puntos clave de las directrices de UNEP/SETAC para el S-LCA incluyendo a los stakeholders, temas sociales e indicadores de resultados, definiendo así un marco de referencia que puede ser adaptado al estudio de caso.

Settembre Blundo, D., Ferrari, A. M., del Hoyo, A. F., Riccardi, M. P., & Garcia Muiña, F. E. (2018). Improving sustainable cultural heritage restoration work through life cycle assessment-based model. *Journal of Cultural Heritage*, 32, 221-231. ÍNDICES DE CALIDAD (2017): Journal Citation Reports: 1,706, Q1; SCOPUS: SJR: 0,562, Q1.

En el artículo anterior se realizó la evaluación de impacto ambiental y social del proceso de restauración, mientras que el objetivo de este trabajo es definir y construir un marco general que incluya todos los indicadores de impacto relacionados con el proceso de restauración (medio ambiente, economía y sociedad) aplicándolos experimentalmente, y por primera vez juntos, a la evaluación de los tres pilares de la sostenibilidad en el sector del Patrimonio Cultural. A continuación, se aplica este modelo LCSA al caso relativo a la restauración a la restauración de la fortaleza de Uncastillo. Los datos recogidos han permitido alcanzar dos objetivos: en primer lugar, validar el modelo de forma empírica y, en segundo lugar, identificar prácticas de gestión exitosas para los responsables de la toma de decisiones.

Settembre-Blundo, D., García-Muiña, F. E., Pini, M., Volpi, L., Siligardi, C., & Ferrari, A. M. (2018). Sustainability as Source of Competitive Advantages in Mature Sectors: The Case of Ceramic District of Sassuolo (Italy). *Smart and Sustainable Built Environment*, aceptado para la publicación. ÍNDICES DE CALIDAD (2017): SCOPUS: SJR: 0,373, Q2

Este artículo pretende validar el modelo de evaluación de impacto de la LCSA mediante su aplicación a otro sistema mesoeconómico: los distritos industriales. El objetivo es por lo tanto explorar cómo la sostenibilidad puede convertirse en una fuente de ventaja competitiva para los sectores manufactureros maduros en los que las tecnologías están estandarizadas y la innovación se genera principalmente a lo largo

de la cadena de valor y no a través de empresas individuales. Desde el punto de vista metodológico, esta investigación estima el estado de sostenibilidad de la producción cerámica en el distrito de Sassuolo (Italia), utilizando el mismo modelo LCSA (aplicado anteriormente al Patrimonio Cultural), y cambiando el punto de observación para el análisis, de la empresa (nivel micro) a todo el sector. (nivel meso). En este trabajo se analizan los impactos ambientales, económicos y sociales de los cuatro principales tipos de baldosas cerámicas fabricadas en Italia, tanto en términos agregados para todo el sector como por metro cuadrado de producto.

Congresos Internacionales

1. **International Workshop on "Rethinking Clusters" - Florencia (Italia) 3-4 de Mayo 2018**. *Developing a Sustainable Restoration Method for the Cultural Heritage of a Small Local community*. (Presentación oral).
2. **International Workshop on "Rethinking Clusters" - Florencia (Italia) 3-4 de Mayo 2018**. *Life cycle sustainability assessment (LCSA) as a method for evaluating and monitoring theevolution of environmental, economic and social performance in the ceramic district of Sassuolo (Italy).* (Presentación oral).
3. **14th CIMTEC International Ceramics Congress – Perugia (Italia) 4-8 Junio 2018.** *Green thinking in the ceramic industry-porcelain stoneware tiles from low-impact raw material*s. (Póster).
4. **24th International Sustainable Development Research Society Conference - Messina (Italia) 13-15 Junio 2018.** *Life cycle assessment of a ceramic tiles manufacturing: strategies for circular economy*. (Presentación oral).
5. **CBIM 2018 (Center for Business and Industrial Marketing) International Conference - Madrid (España) 18-20 Junio 2018**. *Method for designing sustainable business models for ceramic tiles manufacturers based on life cycle approach*. (Presentación oral).

6. **TECNARGILLA 2018: "The Ceramic Industry Towards a Circular Economy Model": International Conference - Rimini (Italia) 26 Septiembre 2018**. *Corporate Social Responsibility: how to integrate the principles of sustainability into business models*. (Presentación oral).

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Resultados y conclusiones

Los principales resultados obtenidos con este proyecto son cinco, que responden a los retos establecidos en los objetivos de investigación. A continuación, se exponen:

1. El nuevo modelo propuesto de análisis de sistemas mesoeconómicos basado en la lógica abductiva y la metodología hermenéutica interpretativa contribuye a la resolución del problema de la insuficiencia explicativa de los modelos funcionales de las ciencias naturales, a la hora de interpretar las numerosas interrelaciones que tienen lugar entre los portadores de intereses involucrados en la gestión del Patrimonio Cultural y de los Distritos Industriales.
2. Como posible resolución al desafío de relacionar la herencia histórica del pasado con la necesidad presente de preservar el Patrimonio Cultural y el medio ambiente para llevarlo a las generaciones futuras como señas de nuestra identidad, se propuso la integración del modelo hermenéutico abductivo con el enfoque del ciclo de vida, en consonancia con los principios de sostenibilidad.
3. De manera pionera se aplicaron las técnicas del ciclo de vida al sector del Patrimonio Cultural y a los Distritos Industriales y siendo posible considerar simultáneamente los tres pilares de la sostenibilidad: medioambiente, economía y sociedad.
4. El resultado de este diseño metodológico fue una nueva herramienta operacional para el análisis y la gestión de los sistemas mesoeconomicos complejos (come son el Patrimonio Cultural y los Distritos Industriales) que se denominó Modelo de "*Mesoeconomic Life Cycle Management*" (M-LCM).
5. Una vez desarrollada la metodología de análisis a nivel teórico, ésta se puso a prueba para los casos de un entorno socioeconómico complejo dentro del sector del Patrimonio Cultural como es la villa de Uncastillo (Zaragoza) y en ambito industrial como es el Distrito Cerámico de Sassuolo en Italia. Esta población y el cluster industrial presentan todas las características y complejidad requeridas (todo tipo de "stakeholders") a la vez que mantiene unas dimensiones accesibles para su estudio. El resultado ha sido un mayor conocimiento de todos los actores y sus interrelaciones que redundará en una mejor gestión futura del conjunto del Patrimonio Cultural del lugar y de la cadena de valor del clusters, cuyo impacto medioambiental y socioeconómico es vital para la subsistencia de ambos.

En conclusión, del estudio se desprenden varias implicaciones tanto para los académicos como para los profesionales.

Conclusiones para el sector del Patrimonio Cultural

A partir de los resultados del estudio de caso de Uncastillo, podemos mostrar algunos hallazgos que pueden ser de interés para los científicos dedicados a la investigación teórica sobre la gestión del Patrimonio Cultural como, por ejemplo:

- la evaluación cuantitativa del impacto ambiental, económico y social de todo el proceso de restauración;
- la definición de criterios y métodos para identificar, priorizar e involucrar a todos los stakeholders en cada etapa del proceso de restauración, conservación y valorización;
- el diseño de un marco completo de indicadores de impacto para la restauración sostenible del Patrimonio Cultural.

Desde el punto de vista de la práctica gerencial, el nuevo modelo de Gestión del Patrimonio Cultural, a través de su aplicación al estudio de caso de Uncastillo, ha demostrado ser capaz de:

- relacionar los diferentes puntos de vista de los especialistas técnicos (históricos, arqueológicos, químicos, físicos, arquitectos, ingenieros y economistas) en un único proyecto integrado para la gestión del Patrimonio Cultural;
- proporcionar una fuente constante de información (técnica, económica y social) para apoyar la toma de decisiones;
- monitorear, de manera sostenible e innovadora, el estado de conservación del Patrimonio Cultural durante su ciclo de vida.

Conclusiones para los Distritos Industriales

En este trabajo se demostró que el enfoque del ciclo de vida ayuda a incorporar el costo social total de un proyecto una transacción económica con efectos ambientales en el precio de los productos, evitando atribuir los costes externos para la comunidad y la respuesta a las deficiencias del mercado. La investigación cierra la brecha entre académicos y profesionales en el campo de la integración de los principios de sostenibilidad en los modelos de negocios y las políticas económicas e industriales para la gobernanza de los territorios.

En una perspectiva teórica, el cambio de la unidad de análisis, de empresa (a nivel micro) a el distrito (a nivel meso), permite tomar en cuenta aquellas externalidades que de otra manera permanecer fuera de las "puertas" de los actores económicos y permitir su transformación en sector internalidades. El modelo M-LCM también resaltó que el transporte de materias primas es uno de los más importantes. factores de impacto, pero sobre todo demostró que no se trata sólo de un coste físico de operación (el transporte de la mina a las fábricas), sino también un coste medioambiental no exclusivamente atribuible a la empresa individual, sino a todo el sector.

Desde el punto de vista de la práctica gerencial, esta investigación experimental ha demostrado cómo el uso de un (el modelo M-LCM) permite cuantificar el impacto económico, ambiental y social de los proyectos, utilizando datos de proceso normalmente disponibles para los agentes económicos y, de otro modo, no siempre utilizados rentablemente. La información proporcionada por las herramientas de LCSA puede proporcionar a las empresas de un sector maduro, tales como como el cerámico, con incentivos para innovar su estrategia competitiva con el fin de crear valor a lo largo de toda la cadena de suministro. Por ejemplo, al reposicionar el producto para colocarlo en un segmento de mercado *premium*, más sensible a los atributos de sostenibilidad

Results and conclusions

The main results obtained with this project are five, which respond to the challenges set out in the research objectives. They are set out below:

1. The proposed new model of mesoeconomic systems analysis based on abductive logic and interpretative hermeneutic methodology contributes to solving the problem of the explanatory insufficiency of the functional models of the natural sciences, when interpreting the numerous interrelations that take place between the stakeholders involved in the management of Cultural Heritage and Industrial Districts.
2. As a possible solution to the challenge of linking the historical heritage of the past with the present need to preserve Cultural Heritage and the environment in order to take it to future generations as signs of our identity, the integration of the abductive hermeneutic model with the life cycle approach was proposed, in line with the principles of sustainability.
3. In a pioneering manner, life cycle techniques were applied to the Cultural Heritage sector and Industrial Districts, and it was possible to simultaneously consider the three pillars of sustainability: environment, economy and society.
4. The result of this methodological design was a new operational tool for the analysis and management of complex mesoeconomic systems (such as Cultural Heritage and Industrial Districts) that was called the "Mesoeconomic Life Cycle Management" (M-LCM) Model.
5. Once the analysis methodology had been developed on a theoretical level, it was tested for cases of a complex socio-economic environment within the Cultural Heritage sector such as the village of Uncastillo (Zaragoza) and in the industrial field such as the Ceramic District of Sassuolo in Italy. This population and the industrial cluster present all the characteristics and complexity required (all types of stakeholders) while maintaining accessible dimensions for study. The result has been a better knowledge of all the actors and their interrelations

that will result in a better future management of the whole of the Cultural Heritage of the place and of the value chain of the clusters, whose environmental and socioeconomic impact is vital for the subsistence of both.

In conclusion, the study has several implications for both academics and practitioners.

Conclusions for the Cultural Heritage sector

From the results of the Uncastillo case study, we can show some findings that may be of interest to scientists engaged in theoretical research on the management of Cultural Heritage, for example:

- quantitative assessment of the environmental, economic and social impact of the entire restoration process;
- the definition of criteria and methods to identify, prioritize and involve all stakeholders at each stage of the restoration, conservation and valorization process;
- the design of a comprehensive framework of impact indicators for the sustainable restoration of Cultural Heritage.

From the point of view of management practice, the new model of Cultural Heritage Management, through its application to the Uncastillo case study, has proven to be capable of:

- to link the different points of view of technical specialists (historians, archaeologists, chemists, physicists, architects, engineers and economists) in a single integrated project for the management of Cultural Heritage;
- to provide a constant source of information (technical, economic and social) to support decision-making;
- to monitor, in a sustainable and innovative way, the state of conservation of Cultural Heritage during its life cycle.

Conclusions for Industrial Districts

This research demonstrated that the life cycle approach helps to incorporate the total social cost of a project into an economic transaction with environmental effects on the price of products, avoiding attributing external costs to the community and responding to market failures. The research closes the gap between academics and practitioners in the field of integrating sustainability principles into business models and economic and industrial policies for territorial governance.

In a theoretical perspective, the change of the unit of analysis from enterprise (at the micro level) to district (at the meso level), allows considering those externalities that otherwise remain outside the "doors" of the economic actors and allow their

transformation into internal sectors. The M-LCM model also highlighted that the transport of raw materials is one of the most important factors. It also demonstrated that it is not only a physical cost of operation (transport from the mine to the factories), but also an environmental cost not exclusively attributable to the individual company, but to the entire sector.

From the point of view of management practice, this experimental research has demonstrated how the use of a (M-LCM model) makes it possible to quantify the economic, environmental and social impact of projects, using process data normally available to economic agents and otherwise not always used profitably. The information provided by LCSA tools can provide companies in a mature sector, such as ceramics, with incentives to innovate their competitive strategy in order to create value along the entire supply chain. For example, repositioning the product to place it in a *premium* market segment, more sensitive to sustainability attributes.

Risultati e conclusioni

I principali risultati ottenuti con questo progetto sono cinque, che rispondono alle sfide poste dagli obiettivi di ricerca. Essi sono elencati di seguito:

1. La proposta di un nuovo modello di analisi per i sistemi mesoeconomici basato su logiche abduttive e metodologie ermeneutiche interpretative, contribuisce a risolvere il problema dell'insufficienza esplicativa dei modelli funzionali delle scienze naturali, nell'interpretare le numerose interrelazioni che si verificano tra i portatori di interessi coinvolti nella gestione dei Beni Culturali e dei Distretti Industriali.
2. Come possibile soluzione alla sfida di collegare il patrimonio storico del passato con l'esigenza presente di preservare i Beni Culturali e l'ambiente per portarlo alle generazioni future come segno della nostra identità, è stata proposta l'integrazione del modello ermeneutico abduttivo con l'approccio del ciclo di vita, in linea con i principi della sostenibilità.
3. In modo pionieristico, le tecniche del ciclo di vita sono state applicate al settore dei Beni Culturali e ai Distretti Industriali, è stato così possibile considerare contemporaneamente i tre pilastri della sostenibilità: ambiente, economia e società.
4. Il risultato di questo disegno metodologico è stato un nuovo strumento operativo per l'analisi e la gestione di sistemi mesoeconomici complessi (come lo sono i Beni Culturali e i Distretti Industriali) che è stato chiamato modello di "Mesoeconomic Life Cycle Management" (M-LCM).

5. Dopo la conclusione dello sviluppo teorico della metodologia di analisi, essa è stata testata in due casi studio rappresentativi di ambiente socioeconomico complesso rispettivamente nel settore dei Beni Culturali con il villaggio di Uncastillo (Saragozza) e nel campo industriale con il Distretto Ceramico di Sassuolo in Italia. Il villaggio di Uncatillo e il cluster industriale di Sassuolo, presentano entrambi tutte le caratteristiche e la complessità richieste per validare il modello, pur mantenendo dimensioni accessibili per lo studio. Il risultato è stata una maggiore conoscenza di tutti gli attori e delle loro interrelazioni che si tradurrà in una migliore gestione futura dell'insieme dei Beni Culturali del luogo e della catena del valore dei cluster, il cui impatto ambientale e socioeconomico è vitale per la sussistenza di entrambi.

In conclusione, i risultati dello studio hanno diverse implicazioni sia accademiche che manageriali.

Conclusioni per il settore dei Beni Culturali

Dai risultati dello studio del caso Uncastillo, si possono evidenziare alcuni risultati che possono essere di interesse per gli studiosi impegnati in ricerche teoriche sulla gestione dei Beni Culturali, ad esempio:

- la valutazione quantitativa dell'impatto ambientale, economico e sociale dell'intero processo di restauro;
- la definizione di criteri e metodi per identificare, dare priorità e coinvolgere tutte le stakeholder in ogni fase del processo di restauro, conservazione e valorizzazione;
- la progettazione di un quadro completo di indicatori di impatto per il restauro sostenibile dei Beni Culturali.

Dal punto di vista della pratica manageriale, il nuovo modello di Gestione dei Beni Culturali, attraverso la sua applicazione al caso studio Uncastillo, ha dimostrato di essere in grado di:

- collegare i diversi punti di vista degli specialisti tecnici (storici, archeologi, archeologi, chimici, fisici, architetti, ingegneri ed economisti) in un unico progetto integrato per la gestione dei Beni Culturali;
- fornire una fonte costante di informazioni (tecniche, economiche e sociali) a sostegno del processo decisionale;
- monitorare, in modo sostenibile e innovativo, lo stato di conservazione dei Beni Culturali durante il loro ciclo di vita.

Conclusioni per i Distretti Industriali

Questo studio ha dimostrato che l'approccio del ciclo di vita aiuta a incorporare il costo sociale totale di un progetto in una transazione economica con effetti ambientali sul prezzo dei prodotti, evitando di attribuire i costi esterni alla comunità e la risposta ai fallimenti del mercato. La ricerca inoltre colma il divario tra ricerca teorica e pratica manageriale nel campo dell'integrazione dei principi di sostenibilità nei modelli di business e nelle politiche economiche e industriali per la governance territoriale.

In una prospettiva teorica, il cambiamento dell'unità di analisi dall'impresa (livello micro) al distretto (livello meso), permette di tenere conto di quelle esternalità che altrimenti rimarrebbero al di fuori delle "porte" degli attori economici e ne consentono la trasformazione in fattori interni. Il modello M-LCM ha anche evidenziato che il trasporto delle materie prime è uno dei fattori di impatto più importanti, ma soprattutto ha dimostrato che non è solo un costo fisico di esercizio (trasporto dalla miniera alle fabbriche), ma anche un costo ambientale non esclusivamente attribuibile alla singola azienda, ma all'intero settore.

Dal punto di vista della pratica manageriale, questa ricerca sperimentale ha dimostrato come l'utilizzo di un modello M-LCM, permetta di quantificare l'impatto economico, ambientale e sociale dei progetti, utilizzando dati di processo normalmente a disposizione degli operatori economici ma che non sempre sono utilizzati con profitto. Le informazioni fornite dagli strumenti di LCSA possono fornire alle aziende di un settore maturo, come la ceramica, incentivi per innovare la propria strategia competitiva al fine di creare valore lungo tutta la catena di fornitura. Ad esempio, riposizionare il prodotto per inserirlo in un segmento di mercato *premium*, più sensibile alle caratteristiche di sostenibilità.

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Apéndice

A continuación, se presentan las publicaciones científicas mencionadas en el texto.

Sponsorship and patronage and beyond

PPP as an innovative practice in the management of cultural heritage

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Abstract

Purpose – The purpose of this paper is to present alternative management practice methods for the cultural heritage sector apart from the traditional public support model. These alternatives rely on sponsorship and patronage as well as the newer and more innovative public-private partnership (PPP).

Design/methodology/approach – The paper is organized in two conceptual sections based on a literature review. The first section presents and compares two closely associated business strategy forms that are increasingly becoming popular within companies: sponsorship and patronage. These strategies are analyzed to show their advantages and disadvantages and are assessed based on their best uses in terms of the benefits from their implementation to all stakeholders involved (benefactors, recipients and the public) and, more particularly, to the benefactor's company communication policy. The second section analyzes the PPP as a newer innovative practice in the cultural heritage sector, a recent development that has great potential, especially during an economic crisis where public funds are reduced, which risks the future recovery and proper maintenance of sites.

Findings – In the paper, the authors stressed that sponsorship, patronage and PPP are not merely alternative ways of primarily obtaining government funding for the cultural heritage sector but are also new strategic management practices that, when properly performed, will not only preserve and improve the sector but also allow more value to be distributed among all stakeholders.

Originality/value – Although the topic of PPP is treated fairly in the scientific literature, especially with regard to infrastructure, there are few cases of the application of this model to cultural heritage management.

Keywords Cultural heritage, Sponsorship, Patronage, Corporate philanthropy, Public-private partnership (PPP)

Paper type Conceptual paper

1. Introduction

Historically, the term patronage has denoted support of the arts by the wealthy ministers and is derived from a practice begun by Maecenas, a rich and powerful Minister under Emperor Augustus and a protector and friend of Virgilius, Horace and other Roman writers (Bowditch, 2010).

In the past, patronage took the form of financial aid and other types of support by kings, princes, aristocrats and landlords to artists (writers, painters, sculptors and musicians) who worked under these patrons' command with relative freedom. In so doing, the artists placed

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their artistic skills in the service of their benefactors, thereby granting them a certain level of prestige (Corredoira, 1991). Currently, these terms are replete with double meanings and particular nuances depending on the local context, industry or business sector, as well as the company size and individual experiences (Lewandowska, 2015).

This paper, through the analysis of the literature on patronage, sponsorship and public-private partnerships (PPPs), aims to contribute to the knowledge of the main forms of cooperation between public and private operators in the management of cultural heritage.

2. Sponsorship and patronage within the donor company frame

Sponsorship and patronage are strategies for corporate public relations that are experiencing a relatively large boom in recent years due to their highly beneficial impact on corporate image (Grohs and Reisinger, 2014). With respect to their objectives, they basically differentiate the tangible benefits obtained from sponsorship while centering on intangible benefits from patronage, in which indirect and subtle means of communication are employed. In addition, it is also important to mention that sponsorship differs from patronage by focusing on sports, a separate field. Therefore, the objective of sponsorship is more commercial in terms of improving the company image from the perspective of the client, while the objectives of patronage involve building a positive social (and more altruistic) image (Herranz de la Casa *et al.*, 2015).

The management of both patronage and sponsorship must consider the corporate image and identity, the communication policy and strategies of the company that promotes the action, the value of the service offered by the sponsored company and/or the quality of its artistic production. Therefore, management goes beyond simple communication techniques in becoming a company's corporate strategy because the strategies directly affect the sponsoring company's image and reputation (Bocşe *et al.*, 2012).

2.1 Sponsorship

Sponsorship activities are institutional actions that project the company's reputation and broadcast its vision of the world and are positively related to corporate reputation (Kim, 2016). This aspect not only considers the client/buyer dimension but also popular interests, such as the enjoyment of sports, the arts, culture, social welfare, etc.

Sports, as a main field of implementation for sponsorship, introduces important value added to the company and the media. The sponsor seeks to benefit from the positive publicity generated through its economic participation in a primarily sports-related event and expects to attain benefits in terms of the company image, which is translated later into higher sales. Therefore, to develop a sponsorship strategy, it is necessary for the company to earmark funds to sponsor an event (Lidström, 2004).

Sponsorship usually involves achieving commercial and image-related objectives. This can be used to obtain a positive company image that offers a better relationship with its targets; this not only considers the client/buyer dimension but also that of people's interests as sports fans.

Among the main objectives of sponsorship is the building of a brand image that is associated with the values of an activity related to the particular sport. In addition, secondary objectives are also involved, such as the revaluation of a product, the increase in the motivation of the sales force, social acceptance, changes in public opinion, increases in media coverage, etc.

The benefits from sponsorship depend on the correct selection of the event and the target audience. Here, the key for success lies in the association between the sponsor's image and the positive qualities of the event.

2.2 Patronage

Patronage is framed within the concept of corporate philanthropy, which is basically relevant to the areas of arts and culture and refers to the financial support of artists (Rebaudengo, 2016) and scientists (Murray, 2013) to allow them to continue their work without requiring immediate results. Another definition is support, either monetary or material, that an organization grants for the social, cultural and scientific development of a society, as well as for the environmental preservation in which it is located. Patronage helps improve the reputation of the organizations that support the endeavors and is considered a valuable public relations strategy (Mazza *et al.*, 1994).

Societal recognition of patronage activities helps maintain the reputation of companies in the long run. Similar to sponsorship, patronage aims to create a positive image and, to a lesser extent, attain commercial objectives. Nevertheless, it offers a new, more altruistic dimension for the company and thereby generates a different relationship with its stakeholders (O'Hagan and Harvey, 2000).

In another sense, patronage, with resources derived from the private sector, does not attempt to substitute either government investment in culture or its essential work in favor of the general public interest. The resources from private benefactors should be added to harmonize with logic and public priorities. The necessary coordination must not be imposed but rather shared through dialogue and combined efforts.

Patronage generates an increase in public awareness and in the local identity of companies through their corporate philanthropy activities, which helps with socio-cultural development, particularly new public groups, by allowing them access to high-quality cultural programs.

2.3 Sponsorship and patronage as corporate social responsibility

Sponsorship and patronage activities should be viewed as commercial and corporate social responsibility activities. Otherwise, sponsorship and patronage serve only as additional commercial paths for a brand or company, similar to that of print or TV advertisements. Under this pure market vision, sponsorship and patronage would become mere advertising instruments to the company and its commercial services (Pérez, 2002).

Hence, sponsorship and patronage activities represent the effort that an organization must undertake in terms of its social responsibility and should be considered from a different point of view with respect to the commercial relationship between the sponsor and the sponsored entities by introducing a key success factor in the development of company activities.

Therefore, these acts involve providing solutions to contribute to causes in the general public interest. This is not only a simple altruistic or charitable concept for a company but is also a new type of business vision that is linked to its corporate social responsibility. Sponsorship and patronage have become an expression of social responsibility that is based on ethics and corporate principles more than advertising and marketing strategies (Uhrich *et al.*, 2014).

3. Literature review

For some time now, researchers have attempted to analyze the importance of business investments in sponsorship and patronage and its relationship to the everyday practices of cultural institutions (Martorella, 1996; Kirchberg, 2003). Nevertheless, in the academic literature, there is no clear conceptual definition of corporate sponsorship (sponsorship) or philanthropic patronage (patronage). This lack of conceptual consensus among researchers is leading some authors to consider them synonymous or slightly different with regard to the scope of action of the company. Hence, if the event is related to sports, the support is considered sponsorship; if the event is cultural in nature, it is considered patronage

(Martínez, 2004). However, Fraiz and Alén (2003) emphasize that possible confusion between the two terms can be resolved based on the nature of the action, regardless of whether profit is made, based on the idea that in no event can patronage or sponsorship be understood as a form of action, whether neutral or disinterested. For a vast majority of researchers, the planned exploitation of the relationship between the sponsor (benefactor) and sponsored (recipient) distinguishes sponsorship, patronage and/or corporate philanthropy (Baux, 1991; Zentes and Deimel, 1991).

On the same basis, corporate donations should be distinguished from sponsorship (Bruhn, 1987). Galaskiewicz and Colman (2006) suggest that different philanthropic tools are motivated in different ways, i.e., sponsorship and donations. Each tool is subjected to different tax treatments. Overall, sponsorship has experienced more favorable tax treatments for donations; therefore, the tax rate will have a stronger impact on sponsorship. In fact, it is important to note that philanthropic investment can be considered one of the possible ways in which a company can invest its profits. Therefore, similar to any other type of investment (such as the recruitment of new staff members or the purchase of new plants), sponsorship and patronage should be considered not only on the basis of motivation but also in terms of its impact on business and the return value for the company (Comunian, 2009).

One of the main benefits that companies can obtain through patronage and sponsorship is the tax advantages associated with these donations (Clotfelter, 1985; Boatsman and Gupta 1996). In this regard, Hanousek *et al.* (2010) explain how the tax rate affects the level of donations if they are motivated by the maximization of managerial utility and, on the contrary, if the tax rate does not affect the level of donations if the firm maximizes its profits. The same authors also show that these predictions are valid for cases where there is a binding limit on tax deductible donations. Therefore, the tax rate of donations may be considered an indicator of the company's motivation to participate in patronage and sponsorship activities.

The most recent literature has attempted to consider the distribution of private investment in the arts in relation to forms of art and geography (Stanziola, 2007). Firms operating locally, nationally and internationally are faced with different conditions and must meet the various expectations of different stakeholder groups. Multinational companies are under the strong influence of stakeholder groups and operate in an environment with high expectations for corporate behavior. These factors increase the pressure on companies to engage in philanthropic activities. In contrast, companies that operate regionally are closer to its stakeholders and the needs of sponsorship and patronage of the local community (Abzug and Webb, 1997). Kotler and Scheff (1997) suggest that investment in cultural sponsorship is more efficient from the viewpoint of their impact on corporate communication because it reaches people in an environment that can be consistent with their personal lifestyles; thus, it is possible to create an emotional bond with the client or the public and specific sets of audiences (Colbert *et al.*, 2005).

The nationality of the owners of the company is a factor that influences patronage and sponsorship. Often, foreign owners transplant the corporate culture of the country of origin into their local subsidiaries, where philanthropic traditions are more established (Bussard *et al.*, 2005). Therefore, it is expected that companies with foreign owners take the initiative in engaging in philanthropy in transition economies, possibly due to better performance. An additional factor explaining the greater propensity of foreign companies for sponsorship and patronage may be a greater need to build relationships and establish its reputation in the country (Meng-Lewis *et al.*, 2013).

Generally speaking, philanthropic investments can also have significant results in terms of improving the business environment in which the company operates. This seems to

undermine the traditional distinction between patronage, simple donation and sponsorship, which exchanges the support of a company with visibility and other services to provide an economic return. In fact, even patronage can have a positive economic impact and generate returns for a company (Porter and Kramer, 2002).

Other authors have examined the types of businesses that donate to cultural endeavors (Leclair and Gordon, 2000). The size of the company is a typical factor that influences spending for grants. It is natural that large companies have more funds available and therefore spend more in absolute terms for patronage, but smaller companies often perform better than large companies (Hanousek *et al.*, 2009). Hanousek *et al.* (2010) identified how corporate donations may be influenced by the sector to which the company belongs. Sponsorship and patronage activities are more important for service companies because they are closer to their customers and must be visible in the community; this is also true for retail firms because they are in direct contact with large groups of consumers.

4. Ethical foundations of patronage and sponsorship

4.1 I give so that you might give (do ut des)[1]

The history of patronage shows that the reasons for supporting such behavior are varied and are certainly not attributable to a single principle (Bearfield, 2009).

First, an unlawful practice that places sponsorship as among the usual obligations of an entrepreneur to his community should be discussed. Often, this is understood as "due compensation" for the establishment of an economic activity and/or production on a territory to reduce the impact made by the new entity (Olson, 2010).

One view is that the exchange is itself unlawful because the benefactor or "patron" shows interest in creating goodwill that magnifies him/herself personally; politicians or recipients, on their part, find the necessary capital to implement interventions that create consensus. A "gift" is such only if it is not viewed as compensation for "debt incurred by the entrepreneur" and is not collected by the administrators (Rifon *et al.*, 2004).

This face of patronage tends to make citizens suspicious. The more they become convinced that there are hidden intentions behind apparent "generosity," the less the public shows interest (Raiborn *et al.*, 2003). Therefore, this behavior appears positive at first glance, but a negative impact on the company's reputation and even on public administration can be observed.

If life in society is an essential condition of existence for the individual person, and if living in a community is a constitutive aspect of human nature, this implies that "dutiful contributions" are not passed off as an expression of "generous donations" but as an obligation. Citizens have obligations toward the public administration and their community; compensation is an obligation. Everything is performed in proportion, and what cannot be calculated is the life and welfare of the community, which has non-negotiable value. In summary, that which is cleverly and surreptitiously grounds for obligation and that which is not performed due to patronage must be gauged.

4.2 Patronage through history

Excluding the *do ut des* issue, patronage remains a complex issue. It is not always possible to identify the issue if these forces are the basis of donations and intervention of the private sector into the public sector. Even the story is not useful for reconstructing the development of this practice. It should be noted, however, that such acts of patronage must be important and worthwhile interventions, leave important impacts in history and make real cultural contributions. Therefore, ethical judgments on the past must be ended, while it remains a duty to be vigilant with respect to the present.

Since the time of Augustus, this praiseworthy behavior was named after his Prime Minister Maecenas or patronage (Gold, 2012). The Renaissance was highly indebted to patrons who supported the creation of real masterpieces; these patrons' intentions are still unknown (MacLean, 2007). Later, patronage was linked to the field of ethics, and Illuminism was perceived as being a form of patronage that was close to the "philanthropy" (Himmelfarb, 2001). It is no coincidence that, with the industrial revolution at the end of the eighteenth century, there was a proliferation of patronage forms for different purposes (Pearson and Richardson, 2001). The motivations for these spontaneous groups were heterogeneous and ranged from vague philanthropic desires to a recognized ethical duty to help those in need. What is being witnessed now is a shift of the phenomenon from individual patronage to associations with more people involved. It should not be forgotten that in the nineteenth century, as a result of industrial development, many entrepreneurs were engaged in charitable activities that left important impacts in the arts and urban development. In many areas in which they established their businesses, their presence became a constant source of significance. Acts of patronage serve as a type of recognition of the business territory because the entrepreneur's wealth was also the result of the work of those involved in the factories.

4.3 Pars destruens: the ethical-philosophical foundation of patronage[2]

Where does one find the ethical value of patronage? Patronage is ethically remarkable when it is performed with a willingness to donate funds for a project that is shared with the users. The active involvement of all stakeholders – from the identification of needs to the proposals and from projects to outputs – has ethical value only if it is based on a platform that unites the various constituencies. A dialogue to identify the "interests" of all is therefore essential to a relationship between the parties. The intervention of a patron is not a "static" act but should rather generate a dynamic that is capable of generating well-being for all involved. The funds must not merely be a gift but rather a gift that triggers processes that are economically beneficial to community development. In this sense, there is an ethical foundation for patronage (Godfrey, 2005).

The stakeholders thus assume an active position and are not merely passive. This requires thinking to identify a project that involves the patron in investments, but these should be aimed at producing the conditions for fruitful activity for the population (Cuypers *et al.*, 2015).

In our opinion, to achieve this goal, there are two required survey instruments. The first concerns the position of the population: how can they play an active role? The second implies that the donation does not end with mere giving but involves the activation of developmental processes over time and requires support of the project over time. The gift must not become a debt.

In doing the above, the patron is not a "good master" but a father figure. Being a father means creating conditions for their children's lives and giving them the opportunity to express themselves according to their aptitudes, dispositions, abilities, interests and desires. If "economy" means the achievement of a goal using the least expensive and quickest route, economy in terms of ethics means to achieve a goal using "human capital," which is identified in the personality of each subject.

5. Sponsorship, patronage and PPP as strategic options

The challenge is to translate an ethical approach, as a gratuitous act, to sponsorship and patronage in business practices. The communications of companies and institutions through these actions are often presented as an important and effective way to achieve leadership and social prestige, especially if the goal is to strengthen local roots and ties with a wide spectrum of stakeholders (Seitanidi and Ryan, 2007).

If most companies offer quality to the general public as a distinctive characteristic of their products, it would also be necessary to develop and possess a powerful image. Hence, the need to consolidate and position its business and corporate image through communication campaigns is based on the support of cultural, scientific, sports or human interest activities. In doing so, and from the company's strategic point of view, the difference between sponsorship and patronage activities for the development of an appropriated company image should be stressed (Martínez Fernández *et al.*, 2005).

With respect to corporate image, patronage underpins the company's public role in public life, while sponsorship seeks to give the company and its brands an improved commercial image. That is, patronage focuses on society (Bearfield, 2009), while sponsorship concentrates on the consumer (Poon and Prendergast, 2006). In addition, patronage tries to offer positive long-term effects (Belk and Andreasen, 1982), while sponsorship seeks to become profitable in the short term (Meenaghan, 2001). Furthermore, the reinforcement of the company's brand image through its fit with more relevant social values is the main objective of patronage, while sponsorship is beholden exclusively to commercial criteria (Meenaghan, 1991). Therefore, the commercial motivation of patronage is weak or non-existent and, on the contrary, the motivation for sponsorship is strong.

In relation to the scope of application, patronage centers on culture (Feingold, 1987), although it has also been applied to social causes recently. On the contrary, sponsorship is aimed at activities that are related to macro mass events, such as sports and music events (Kim, 2010). With respect to the target audience, on one hand, patronage interacts with smaller, more specific groups with few possibilities of obtaining advertising and commercial advantages due to the nature of the event. On the other hand, sponsorship works with much larger audiences as a result of the larger coverage of the event (Palmer *et al.*, 2017).

With regard to the advertising and commercial exploitation of an event, patronage is quite limited itself by its own nature and, in some cases, it becomes totally non-viable. On the contrary, sponsorship must be made profitable through its advertising effects (Olson and Thjømøe, 2009). Patronage does not remove a relationship between the event and the company that sponsors it; however, for sponsorship, there must be a relationship between the event and the product that it sells, which also must be properly highlighted in the relationship (Gwinner and Eaton, 1999).

Finally, with respect to the area of communication, patronage is clearly placed within public relations (Bearfield, 2009), while sponsorship also relates to advertising and, in many cases, sales promotion and other mixed marketing techniques (Javalgi *et al.*, 1994).

5.1 An innovative practice for cultural heritage management

The likelihood of public budget cuts in an economic recession should be a concern for those working in the management of cultural heritage because this field is the first target for decreases. These cuts risk the loss of any positive effect of overall conservation efforts. The impact of restoration must be expanded, become perceptible and, above all, must be compulsory in terms of investments and social report outcomes of interventions. Given the scarcity of resources, choices for intervention must be relevant to the assessment of expected utility, and tangible investment for cultural heritage preservation must be demonstrated.

Therefore, the logic of total public expense on maintenance, as well as support activities and interventions that mobilize private resources should prevail. Here, there is a need to create innovative and profitable uses of cultural heritage as a whole, in which maintenance is part of the process of ordinary activities and productive use, as has always been the case.

The challenge is to systematize skills and responsibilities in integrated projects that consistently involve cooperation between different operators (public and private entities in various sectors, supply chain integration, etc.). Integration between the different stakeholders involved is required; the more heterogeneous and complementary they are

in their respective areas of origin, the better they are for the synergic final results. For this to happen, stakeholders must already have an idea regarding the common benefit of cultural heritage and, therefore, the need to building skills and strategies to experience the effects in cultural heritage management.

The public administration must find appropriate tools for the involvement of private entities in the management plans; patronage and sponsorship certainly represent possible strategic options. However, this requires the sharing of common behavior by both private and public entities. Nevertheless, there are problems for both public and private entities. On one hand, the political time horizon is characterized by short mandates, and the choices of administrators may therefore be influenced by the need to maintain or increase the political consensus in the short term by adopting more conjectural strategies. On the other hand, private enterprises are more frequently involved in speculative phenomena, where there is a preference for immediate high returns. To counteract these opportunistic behaviors, it is necessary for both parties to adopt a business plan for growth and profitability over the medium to long term with a structural perspective that is in line with the community needs.

One tool that promotes cultural heritage and allows the culture to act as a protagonist in the revitalization and redevelopment of cities and territories is the PPP. This tool takes into account the public enjoyment of art and culture while combining social utility and profit and, within the same initiative, bringing together public and private resources and responsibilities (Martinoni, 2006). The private sector therefore becomes the bearer of the respectful treatment of economic principles and the "leader" of action aimed at valorization of cultural heritage through involvement that goes beyond patronage and occasional sponsorships. The use of this procedure, which is a regulated private activity but is essentially aimed at public work, is connected with progressive and relentless growth in Italy.

5.2 Cultural heritage and PPP

The PPP is a mode of implementation or management of a public work, or a public service, of which the public administration is responsible and which provides funding through the use of private capital (Wang and Zhao, 2014). The PPP has origin in the affirmation of the principles of new public management and refers to the use of privatization practices and the outsourcing of public functions, which are to guarantee the efficiency and effectiveness of public spending (Reynaers, 2014).

Collaboration between public and private institutions to valorize the cultural heritage and promote it as an asset for the development of territories, has gained more and more popularity in recent years (Dubini *et al.*, 2012), as well as for restoration of individual heritage buildings (Rypkema and Cheong, 2012). Many competent authorities engaged in cultural conservation are often understaffed and are unable to find professional replacements for many years. They are also not able to deploy management skills to enhance cultural heritage. However, the adoption of new forms of cooperation between the public and private sector has shown the ability to provide real opportunities to improving the economic sustainability of public assets involving private companies that specialize in the supply of services for amelioration and valorization. Of course, the involvement of private entities should not challenge the ownership heritage, and therefore, strict rules on use and preservation must be observed (Macdonald and Cheong, 2014).

From the economic and financial point of view, the preservation of cultural heritage can be classified among the "weak" projects, because the remuneration generated through revenue from user is normally not sufficient to adequately remunerate the private investor, especially in the case of concession of works, over and about, that of public services (Bowitz and Ibenholt, 2009). This may involve the need for public contribution for the realization of the restoration and preservation of cultural heritage (Trupiano, 2005).

The outsourcing of "non-core assets" is a global trend, which involves a recognized social advantage and is strongly supported by EU law to address the scarcity of resources. Outsourcing must be performed in accordance with market logic to prevent any "improper burden" of intermediation that reduces the levels of efficiency that are deemed indispensable. The regulation of the concept of PPP comes from the "Green Book" of the European Commission, which was presented on April 30, 2004 and is related to PPPs and Community law on public contracts and concessions.

According to the "Green Book", the PPPs can be distinguished as follows:

- PPP contracts: where the partnership is based solely on contractual links and may fall within the scope of the European directives on public procurement (sponsorship, service concession, contract availability and project financing); and
- institutionalized PPPs: involving cooperation in the framework of a separate entity and may lead to the creation of a new organization owned jointly (companies with public-private capital, cultural consortiums, cultural associations and cultural foundations).

All forms of PPP are characterized by long-term contracts or conventions where the public administration has the function of regulating, organizing and controlling the activities covered by the agreement, whose implementation and management is entitled responsibility of private economic operator (Boyer *et al.*, 2015). However, in the field of cultural heritage the application of PPPs can present some typical critical issues already observed in other sectors:

- the high administrative risk due to the plurality of interests involved and the particular forms of legal protection to which the cultural heritage is subjected (Carbonara and Pellegrino, 2014);
- the allocation of risks between the public and private partners, through which risks for the public sector are usually transferred (Liu *et al.*, 2014);
- the relatively long duration of the collaboration, which involves cooperation between the public partner and the private partner in relation to various aspects of a project to be implemented (Kwak *et al.*, 2009);
- the innovation that the collaboration between public and private has to produce, the expectations related to innovative results in a PPP are higher than other forms of collaboration (Hodge and Greve, 2017);
- the complexity of contract awarding procedures (Klijn and Koppenjan, 2016);
- the inadequate managerial and leadership capacity within the public administration (Frisby *et al.*, 2004); and
- finally, we suggest, the inadequacy of historical/artistic and technical skills of private operators.

5.3 The PPP for the Italian cultural heritage

Italy has been recognized as a world leader in the field of conservation and restoration of cultural heritage and, more recently, it has performed much work as part of its valorization efforts. In particular, the state and municipalities adopt the PPP models for the management of cultural heritage sites through a tendering process. The involvement of private entities is an extraordinary contribution for Italian cultural heritage activities because public resources are not always able to meet all the needs related to the maintenance and management of the artistic treasures of the country. Private resources now contribute actively to the promotion of cultural heritage sites in Italian cities and landscapes, providing

a significant impetus for the economy and stimulating the growth of human, technical, organizational and entrepreneurial resources (Ventura *et al.*, 2016).

For the management of cultural heritage, the Italian legislation has introduced a "Strategic Plan for Cultural Development" involving agreements between the state, regions and other public entities that are defined as geographical areas and promotes the integration of infrastructure and related industries in the process of exploitation[3]. Legal support was offered to local governments to adopt a strategic plan for the improvement of cultural heritage sites and to establish priorities. The criteria that must be standardized to the individual projects will refer to the plan, as well as the procedures that will govern the actions of the administration and the cooperative public/private valorization.

Within the Strategic Plan for Cultural Development, another step in the involvement of private parties in the management of cultural heritage is the use of project financing. This tool, in fact, implies that private entities are given an active role in the creation, management and especially in the assumption of total or partial costs of public works in view of future revenues. In Italy, project financing for cultural heritage activities is proving to be the optimal procedure which, through an administered competition, entrusts the implementation of an investment plan that is economically and financially capable of raising the level of infrastructure for cultural heritage and increases the potential for its use to realize full valorization.

The activation of project financing requires the retrieval of public resources to be allocated to the co-financing of the restructuring investments. Co-financing is necessary to provide, as part of the systematic intervention, the recovery of the cultural heritage identified beyond the areas directly devoted to economically sustainable functioning.

Figure 1 shows the diagram of the procedure that involves a call for tenders from the administration on the basis of a feasibility study and an invitation for interested parties to submit proposals for preliminary design work. On the basis of the economically most advantageous proposal, the administration proceeds to identify the best offer, the bearer of which becomes the contractor.

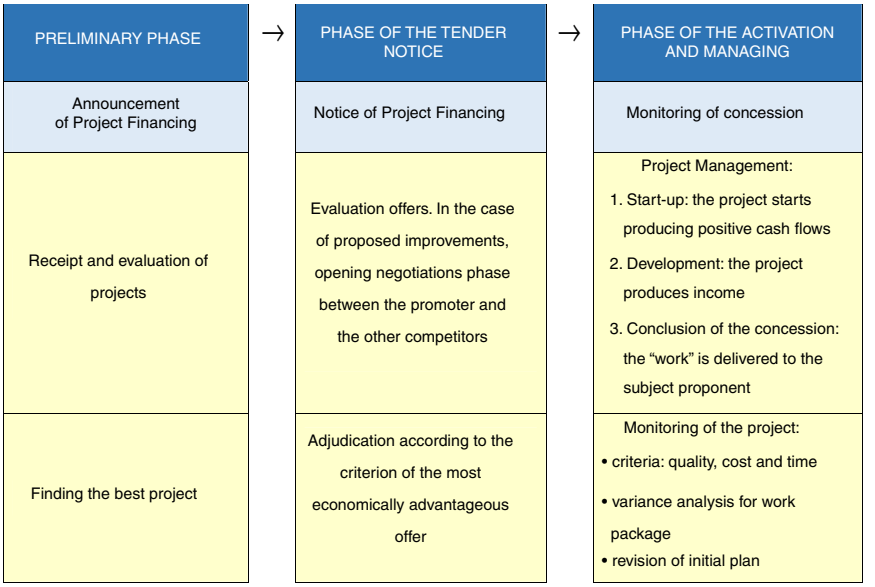

Figure 1.
The diagram of the procedure of Strategic Plan for Cultural Development

The Italian model of project financing for building public-private relationships can be a great business and administrative opportunity that allows enterprises to plan their development in a sustainable way and organizes resources through multiannual management and public facilities programs of high standards of restoration and valorization to providing better services to citizens. Above all, this model can trigger a virtuous circle to turn an investment with private resources devoted to infrastructure to the use (broadly defined) of state museums and archaeological areas, which are chronically deficient in terms of resources.

A comprehensive framework for the Italian cultural heritage PPP is shown in Figure 2, in which we have schematized the governance mechanism for the joint management of the historical and architectural complex and the efforts to involve the private sector in the process of restoration, management and valorization. The complexity, plurality and numerosity of the stakeholders involved in the management of cultural heritage need an adequate instrument of governance, such as the PPP. Under this system of governance, the coordinating instruments mainly adopted in the Italian case are the Institutionalized PPPs of the main stakeholders. It must define the strategic development plan, call a public concession tender and stipulate contracts with private companies. Private companies prepare and implement the technical and financial plans for the restoration under the control and monitoring of the public authority. After the restoration, the management and promotion of cultural heritage, which is always under public control is also entrusted to the private companies.

6. Conclusions

This paper contributes to a growing literature on the cultural heritage management, providing a theoretical conceptualization of the main forms of cooperation between public and private sectors.

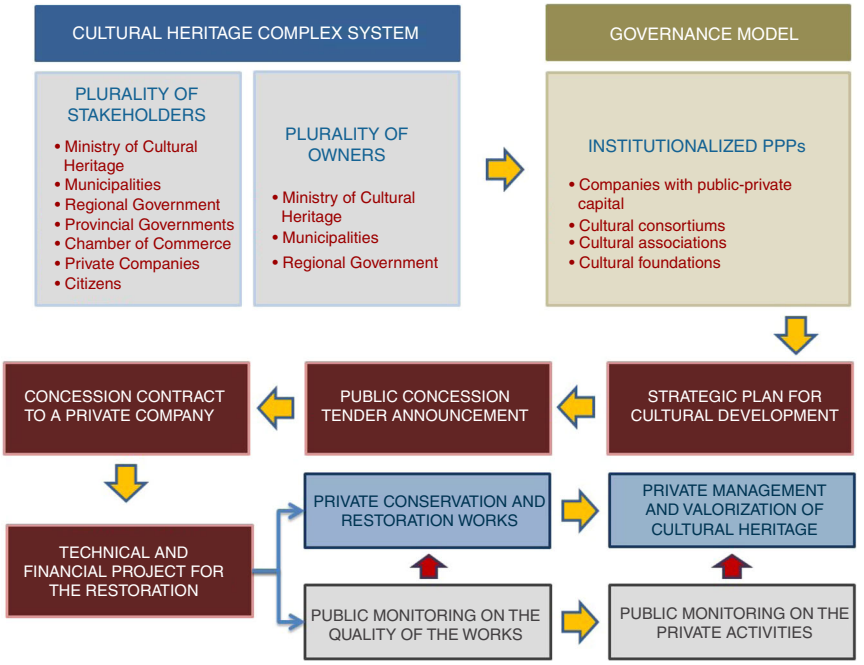

Figure 2. Schematized framework of an Italian case of Cultural Heritage Public Private Partnership

From the point of view of private operators, sponsorship and patronage are two distinct communication strategies with corporate projections. As such, these terms should not be confused or used improperly. Patronage improves the "visibility" of a company within its environment without involving strong resistance; it is a strategy that generates significant social acceptance effects. In turn, sponsorship makes the economic collaboration between the company and the sponsored project even more visible due to its projection through the "mass media," but the pure social effectiveness of this method of economic collaboration is less evident, although it has a huge commercial effect.

It should be not forgotten that a company must pursue economic results as a way to guarantee its effectiveness. The use of patronage as a pivotal center responds to social needs and allows the company to have a dialogue with the citizens serving her/his cultural demands, thereby creating a strong link based on mutual benefit and synergies. The companies that want to devote part of their resources to these types of activities must have expert teams in the relevant areas to manage issues; in doing so, they would avoid the problem of a simple economic donation without a strategic projection.

Therefore, real corporate philanthropic activities (sponsorship and patronage) require specialized instruments and the freedom of action according to the objectives – for example, a foundation that can manage restoration activities with autonomy and professionalism. The company supports the foundation, which, in turn, provides more responsible support – that is, patronage.

Finally, and from the point of view of cultural institutions, patronage and sponsorship are two advantageous forms of funding. Access to funding is becoming increasingly difficult, especially in economic crises that in turn increase the reduction of the already scarce public resources allocated to enhancing and safeguarding the cultural heritage sites. Under these circumstances, obtaining the sponsorship or patronage of private lenders will increasingly depend on the ability of cultural institutions to offer competitive cultural projects from the viewpoint of quality, innovation and attractiveness in terms of financial sustainability.

The beneficiaries of such financing must necessarily operate in a transparent form to report and demonstrate that the acquired resources have been used in line with the objectives of the sponsored project, which is subject to legal aid (Hinna, 2002). Transparent reporting that is clear and understandable is a necessary "viaticum" for cultural institutions that want to maintain a fruitful dialogue not only with sponsors and institutional funders but also with the entire community (Gray *et al.*, 1996). To this end, it is appropriate that cultural institutions are likely to enable learning paths based on management principles and cost control initiative tools that are undertaken with the support of external powers. Keeping resources under control is a managerial imperative for all socio-economic realities, including the cultural-related work with public financing. Only institutions that have such a cultural awareness and are open to integrating their knowledge with the economic expertise will be able to design cultural projects worthy of sponsorship and patronage and to fully develop a social consensus (Viviani, 1999).

On the other hand, the most important managerial implications of this research are:

- First to have clarified that the diffusion of sponsorship and patronage, especially in non-expansionary times, has been hampered by the very nature of this contractual relationship. In fact, the return of the cost incurred by the sponsor (in economic terms) or patron (in terms of reputation) is a structure resulting only indirectly from the operation, being linked to the positive impact that the participation of a private operator will have on an activity of restoration, preservation or valorization of cultural heritage.
- Second, for a more effective involvement of the private in the management of cultural heritage we have identified in the PPP contracts, the most appropriate tools to enable the private investor to directly obtain the return on investment sustained.

- Third, the institutionalized PPPs characterized by the presence in the share capital of both public and private (such as companies with public-private capital and cultural consortiums), respond to the need for the public administration to implement efficient management of cultural heritage, reducing its financial commitments and acquiring outside the professional and managerial skills that are lacking.

Finally, we have proposed as an example of application of these innovative management models: the Italian experience. To encourage the integration of knowledge, the Italian legislature has encouraged the development of forms of public-private cooperation, such as the PPP. More innovative forms of cooperation are possible between public and private entities, through which their resources and capabilities are integrated to ensure better management of cultural heritage sites.

Suggested further research should focus on deepening the topic of risk management between public and private operators. In fact, the importance of risk transfer to the private partner is essential and characteristic of a PPP, but in the management of cultural heritage, as opposed to other works of public interest, this critical issue has not yet been fully investigated. The tangible and intangible dimensions of cultural heritage make same particularly difficult: specially, the finding of an equilibrium between the legitimate private operator's needs to derive profit from the cultural heritage management and the legal obligation (in Italy under the Constitution) to protect and valorize the cultural heritage and preserve it for future generations in its historical and artistic integrity. This ethical dimension added to the already mentioned material and immaterial dimensions, thus, constitute the delicate and complex field of action.

Notes

1. An older Roman law provides names for various ways of forming contracts and for various types of contracts that fell within these forms. The most important class of contract was the "unnamed contract" – for example, *do ut des*, translated as "I give (something) to you so that you may give (something to me)."
2. *Pars destruens*/*pars construens* (Lat.) is common parlance for different parts of an argument. The negative aspect of criticizing views is *pars destruens*.
3. Legislative decree: January 22, 2004, n. 42. *Codice dei beni culturali e del paesaggio*.

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NEW PARADIGM IN URBAN DEVELOPMENT: LIFE CYCLE THINKING AND SUSTAINABILITY

Environmental and social impact assessment of cultural heritage restoration and its application to the Uncastillo Fortress

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Abstract

Purpose The restoration of cultural heritage, like in other production sectors, requires an innovative approach to integrate the principles of sustainability into processes. The main purpose of this article is to demonstrate that an integrated environmental and social impact assessment of restoration works can be conducted through the use of an operational model, which for the first time is applied to a real case of public private partnership (PPP) in the cultural heritage sector.

Methods The evaluation of the proposed strategy is carried out through an approach based on life cycle assessment (LCA) methodology, which takes into account environmental and social aspects. An environmental LCA analysis was conducted on a case study, assessing the effects of an intervention of a historical site that was restored to become a museum. The social effects arising from the intervention were then examined and evaluated with an approach based on the key points of the UNEP/SETAC S-LCA guidelines involving stakeholders, social topics, and performance indicators, thus defining a reference framework that can be adapted to the case study.

Results and discussion The environmental LCA analysis identified the phases of the restoration with the most impact as those related to the reconstruction of materials and elements that was necessary when the originals were too damaged to be recovered. The use and periodic replacement of electronic equipment in the museum also had a significant impact in the use phase of the buildings. The evaluation method for the social aspects scored each social theme, outlining the benefits produced by the restoration. The results show that the restoration had several positive effects, particularly in terms of social issues related to the local community.

Conclusions The environmental LCA assessed the advantages and the hotspots in the recovery and reuse of heritage buildings. The framework developed from the guidelines for the S-LCA of products is a suitable tool for the evaluation of social aspects related to cultural heritage interventions, after adapting the methodology of S-LCA to the context and to the reference case study. In some cases, evaluations are based on subjective judgments, but the results provide a reliable overview of the social impact generated.

Keywords Cultural heritage · Enhancement · Environmental impact · Life cycle assessment · Life cycle sustainability assessment · Social impact · Social life cycle assessment

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1 Introduction

Recent changes in the global environment (Bouleau and Pont 2015) and within human society (Stone et al. 2013) have occurred so rapidly that it is very difficult to control and manage them (Dutta 2016). The twenty-first century has seen massive environmental degradation, depletion of resources, increased poverty, and cultural homogenization (Parr 2016). Consequently, the idea of what development does or should mean has also rapidly evolved (Loulanski 2006; Ferilli et al. 2015).

The exponential increase in the numbers of people moving to cities has led to the rapid growth of urban areas, which is

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expected to continue in the near future (Obermayr 2017). New urban planning strategies based on sustainable development from an environmental, social, and economic point of view should therefore be investigated (Guzmán et al. 2017).

The potential and value of existing building stock is recognized as part of sustainable development. In recent years, many studies have highlighted the value of historic and other buildings in developing sustainable communities (Jensen et al. 2015). They can have tangible environmental benefits related to the energy already spent in the material construction embodied within them and less tangible benefits such as place identity and social cohesion (Orbasli and Barch 2009).

In 1996, the United Nations policy framework declared that "Historical places, objects and manifestations of cultural, scientific, symbolic, spiritual and religious value are important expressions of the culture, identity and religious beliefs of societies […]. Conservation, rehabilitation and culturally sensitive adaptive reuse of urban, rural and architectural heritage are also in accordance with the sustainable use of natural and human made resources".

In this framework, achieving sustainability through the enhancement of heritage buildings is widely acknowledged as important, both for ensuring the continuity of values and for preserving the nonrenewable resources consumed in heritage building practices (Akande et al. 2016). The built environment and heritage buildings are well-known media in sustainable development studies (Cocen and Baniotopoulos 2013).

The study aims to explore if an approach based on life cycle assessment methodology can be used to evaluate the potential of cultural heritage as promoting sustainable development, which is defined as "a development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland and Khalid 1987). The concept of sustainability is based on what are referred to as the "three pillars" of environmental, social, and economic sustainability. Since the Earth Summit in Rio in 1992, this tripartite definition has been commonly accepted by international agencies (Lehtonen 2004), and a tool to assess all three aspects of sustainability for a product, and their interactions, is required.

The challenge is to integrate and balance the environmental, economic, and social aspects in sustainable development, and then identify indicators that capture the interrelationships of these three dimensions of development (Govindan et al. 2016). However, social and cultural sustainability indicators are difficult to detect and quantify (Magis and Shinn 2009), so they must be chosen coherently within the context of analysis. Appropriate monitoring and mapping methods should be used to examine the level and evolution of social and cultural sustainability (Axelsson et al. 2013).

Sustainability assessment has been the subject of many studies and research and has become a common practice in evaluations of products, policies, and institutions (Valdivia et al. 2011). The process supports decision-makers in addressing the main global, national, or local challenges (Ness et al. 2007), by effectively establishing what (impacts), where (in what place), when (in which time), and who (stakeholders) are involved. Based on a detailed review of the literature, Arodudu et al. (2017) define the basic elements of each of these dimensions. Sustainability assessment can be at the local or regional level, depending on the degree of detail required; the temporal dimension can be short, medium, or long term; involved stakeholders can be divided into decision-makers and decision-takers; and the impact dimensions refer to the three pillars of environment, economy, and social sustainability.

Any decision-making process is evaluated in a sustainability assessment according to the measurement and comparability of the results achieved. Sustainability requires appropriate observable, demonstrable, measurable, and comparable indicators (Waas et al. 2014). Many indicators, methods/methodologies, and models have been developed in the field of sustainability research and have been categorized using specific criteria (Sala et al. 2015). Sustainability indicators are multidimensional and multidisciplinary indices that quantify the status of an activity in terms of progress toward sustainability (Ciegis et al. 2015a, b).

A life cycle approach to integrated sustainability assessments has been explored within the LCA methodology (UNEP/SETAC 2011), as "life cycle thinking" is one of the most effective methods for assessing sustainability (Pereira and Soares 2016). Each process action can be considered, which reflects that the main stakeholders cannot possibly limit their responsibilities to the phases of the life cycle of a product, process, or activity in which they are directly involved. The scope of their responsibilities is thus extended throughout the entire life cycle (Baitz 2017).

The methodology combines an environmental life cycle assessment (LCA) of a product, process, or activity with an assessment of social aspects, through the social life cycle assessment (S-LCA) tool (van Haaster et al. 2017) and of economic aspects using life cycle costing (LCC) (Ciroth et al. 2016). LCA and S-LCA have a common conceptual foundation in LCT, so they share the same purpose. Their aim is to determine the environmental and socioeconomic impacts from "cradle to grave" for the same product, service, or activity (Parent et al. 2013). However, the two models are substantially different. First, the functional unit definition is easily determined in the environmental impact assessment but less so in the evaluation of social impact, where even the system boundaries can be unclear (Sala et al. 2016).

The first part of this research focuses on environmental aspects, with the aim of assessing the advantages and the critical points in the restoration and reuse of heritage buildings. In recent years, an extensive body of literature has focused on building sustainability based on the life cycle

approach (Singh et al. 2011; Ortiz et al. 2009). However, the implementation of the LCA methodology is still uncommon in the field of cultural heritage (Pini 2015).

Building reuse and restoration is an alternative to demolition and reconstruction as the consumption of new construction materials is reduced and waste production minimized. These environmental benefits are often associated with economic advantages but depend on the nature of the conservation of buildings (Laefer and Manke 2008). An environmental LCA enables a prior assessment of the intervention required and an evaluation of the best strategies to adopt (Bragança et al. 2010).

However, in the sustainability assessment of restoration processes, cultural heritage cannot be disregarded. This is an important part of societal and community well-being, as it contributes to the creation of cultural identity and a sense of belonging. Social aspects are therefore fundamental to the understanding of the cultural heritage-sustainability relationship (Atakul et al. 2014).

The second part of the research focuses on social aspects related to the restoration and enhancement of cultural heritage.

The Council of Europe Framework Convention on the Value of Cultural Heritage for Society, also known as the Faro Convention, defines cultural heritage as "a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time" (Council of Europe 2005). The Convention is an instrument created to provide guiding principles for the conservation and management of cultural heritage, starting from the concept that the preservation of cultural heritage and its sustainable management are objectives for human development and life quality (Carmosino 2013). This marks a shift from a vision of cultural heritage (tangible or intangible) as a type of goods that needs to be protected only for its intrinsic or scientific value, to an idea of its value measured also as a function of its contribution to human development and the improvement of life quality (Loulanski 2006). Golinelli (2016) highlights the cultural value of the environment as a testimony of civilization and as a result of the dynamic evolution of the relationship between man and nature. From this perspective, it is possible to develop models of enhancement of cultural heritage in a sustainable way.

The focus is not on the cultural heritage in itself but on the people, their relationship with the environment, and their participation in the recognition of cultural values. Cultural heritage enhancement becomes an instrument of sustainable development, and the right to cultural heritage is recognized as a part of the right to participate in cultural life, as defined in Article 27 of the "Universal Declaration of Human Rights" of 1948, and consequently as a source of individual or collective benefits and corresponding responsibilities (General Assembly of UN 1948).

The potential positive social impact generated by an intervention for the recovery of cultural heritage is extensive.

Some buildings are purposely built to last longer than a single generation. They can be considered timeless, because their nature leads them to become part of the heritage of many generations. The preservation of this heritage, which means the extension of its lifetime, results in the conservation of the historical values and evidence they represent (Mora 2007).

The rehabilitation of buildings or monuments, whether their functions are preserved or not, also adds vibrancy to communities through increased inward investment due to the attractiveness and increased safety of a place or the benefits of a growing tourism economy (Cinieri and Zamperini 2013). In particular, the positive economic effects, in terms of increased incomes and job opportunities, serve to reinforce the concept of cultural heritage restoration, as restoration is an activity that requires much manpower, and jobs in this field are relatively well paid. The economic repercussions do not end with the completion of the work but continue throughout the use phase of the recovered building. The creation of jobs often continues during the use phase, covering factors closely linked to the function of the building and to the environment where the building or monument is located, within its local community (Rypkema 2009; Nypan 2007).

Cultural heritage should therefore not simply be regarded as only an object of conservation and restoration but as an incentive for sustainable development, as it uses existing resources to support the local economy, as required by the Faro Convention (Gražulevičiūtė 2006).

The Convention calls upon member states to develop a participative process of cultural heritage enhancement, in which citizens can also have an active role, based on the synergy between public institutions and private organizations. The participation of both individuals and the community is the key to increasing European citizens' awareness of the value of cultural heritage and its contribution to well-being and quality of life.

2 Methods

2.1 Case study

The aim of this research is to assess the environmental and social aspects of cultural heritage restoration through an approach based on LCA methodology. A real case study has been assessed.

The case study is the restoration of a medieval fortress located in the small village of Uncastillo near Zaragoza (Spain), which after the intervention became a museum of medieval local history. The intervention was promoted by

the Uncastillo Foundation, an organization with public and private funding set up to contribute to the preservation and promotion of the cultural heritage of Uncastillo and the surrounding territory (Fundaciòn Uncastillo 2011).

The fortress is located on the top of a hill overlooking the valley and is a distinctive characteristic of the landscape (Fig. 1). The history of the fortress dates back to the tenth century A.D., when a wooden *castrum* was built by order of King Sancho Garcés I of Pamplona to defend the south of his territory, due to the hostilities between Christians and Muslims during this period.

In the eleventh century, a sandstone tower called "Torre del Homenaje" was built on the site of the original wooden structure. In later centuries, the fortress enjoyed a renaissance that led to the construction of the Gothic Palace of Pedro IV in the fourteenth century.

A slow decline began in the fifteenth century, and the fortress fell into a state of severe deterioration, until in 1966, the village of Uncastillo was declared a Historic-Artistic site. In 1985, the fortress was declared a site of particular cultural interest.

The first intervention made by the Uncastillo Foundation was the development of pedestrian access in 2001: the original pathway was made more accessible by widening it, new paving with gravel and stone was created, and safety systems such as steel handrails were added.

The second step was the restoration of the tower, which was carried out between 2001 and 2003. The tower is made of variable sizes of stone and its height is 18.90 m. To ensure it could be defended, the only access to the tower was a "postern," a small door located 6 m from the ground, reachable by a removable staircase. At the time of the intervention, there was also no connection between the four internal floors.

The intervention has made the tower accessible through the addition of an external staircase leading to the postern (Fig. 2) and an internal staircase connecting the floors and internal flooring with sandstone slabs. The last floor now consists of a terrace where the flooring was restored and a skylight added to allow access to the outside.

Fig. 2 The Homenaje Tower after the restoration

The third step of the intervention was the restoration of the gothic Palace of Pedro IV, conducted between 2003 and 2008. The palace originally had two floors, but at the time of restoration, there was only an uncovered ground floor (Fig. 3a). There is an octagonal tower 20 m high leaning against the building, with a stone spiral staircase to access the first floor. At the time of the restoration, the staircase was partially destroyed and the tower was uncovered.

A skylight was created from steel and glass to cover the octagonal tower, and the missing part of the stone spiral staircase was replaced with a steel one. The palatine room walls on the ground floor were reconstructed using many of the original stones, which were found scattered around the palace. The vaults were restored using some of the original quoins and the missing ones were reconstructed (Fig. 3b).

After the restoration of the palace, a new small building was constructed to host services for the visitors, including the ticket office and toilets.

The fortress constitutes a very strong point of reference and identification for the population of Uncastillo, and the

Fig. 1 View of the fortress from Uncastillo village

Fig. 3 Pedro Palace before (**a**) and during the restoration work (**b**)

intervention was aimed at recovering its historic value to the local community. By applying sustainable management to its new function, the aim was to generate wealth and improve the living conditions of the inhabitants of Uncastillo and its surroundings.

The intervention is thus an interesting case study with which to examine both environmental and social aspects. In 2014, Settembre Blundo et al. applied a new theoretical/conceptual protocol of analysis based on the life cycle management model (LCM) to the context of cultural heritage. In this research, the authors defined a theoretical background for integrating impact assessment tools (LCA +LCC+S-LCA) to create an operational tool, providing cultural heritage professionals with a procedural framework for applying sustainability principles to the restoration of works of art. The theoretical model, which the authors refer to as cultural heritage life cycle management or CH-LCM, sets out the sequential steps to conduct both economic and social environmental impact assessments, and to provide interpretative tools to produce structured information from the results that can support decision-making processes. The authors also validated their method through several case studies, including the Uncastillo village.

This research is closely linked to that of Settembre Blundo et al. as the aim is to validate the CH-LCM model through its first application to a real case of restoration (Sargent 2015). The village of Uncastillo is an ideal example for the validation of the CH-LCM model. The foundation that manages the restoration, maintenance, and development of the architectural complex is a good example of the public private partnership (PPP), an innovative managerial practice method for the cultural heritage sector and an alternative to the traditional public support model (Settembre Blundo et al. 2014). It is a unique example on a small scale, and it contains all the economic and social aspects of a complex cultural heritage socioeconomic system. There are many diverse stakeholders with different expectations but with a common goal: the sustainable development of the territory. These specific characteristics make the village of Uncastillo a best-case study for validating the theoretical model and to ensure that the operative protocol can be successfully applied to other cases of cultural heritage restoration.

Italy has 51 UNESCO World Heritage Sites and is thus the country with the greatest potential for the application of the results of our research. This artistic richness is matched by more than 46,000 protected architectural assets and over 16,000 statements of cultural interest (MiBAC, Italian Ministry of Cultural Heritage and Activities and Tourism 2014), which are all opportunities to introduce the sustainable restoration approach. Similarly, Spain, with its 48 UNESCO World Heritage Site and over 17,000 sites of cultural interest, is a country with great potential for the implementation of sustainable restoration (MECD, Ministry of Education, Culture and Sport of Spain 2017).

2.2 Environmental analysis

A detailed LCA analysis was conducted to evaluate the environmental impact generated by the restoration process, taking into account all life cycle stages related to the restoration, over a lifespan of 100 years.

2.2.1 Goal and scope definition

The purpose of this part of the study is to assess the environmental impact of the restoration of a historical building complex of the tenth century, the Uncastillo Fortress.

2.2.2 Functional unit, function of the system, and system boundaries

The function of the system is as historical evidence: the fortress represents the origin of the town and is a landmark, and the population's cultural identification with it is strong. The intervention is aimed at preserving and enhancing the complex, to maintain these characteristics.

The functional unit is the complex consisting of the Homenaje Tower, the Pedro IV Palace, and the access pathway, and the restoration carried out from 2001 onwards is considered and the life cycle over 100 years is analyzed.

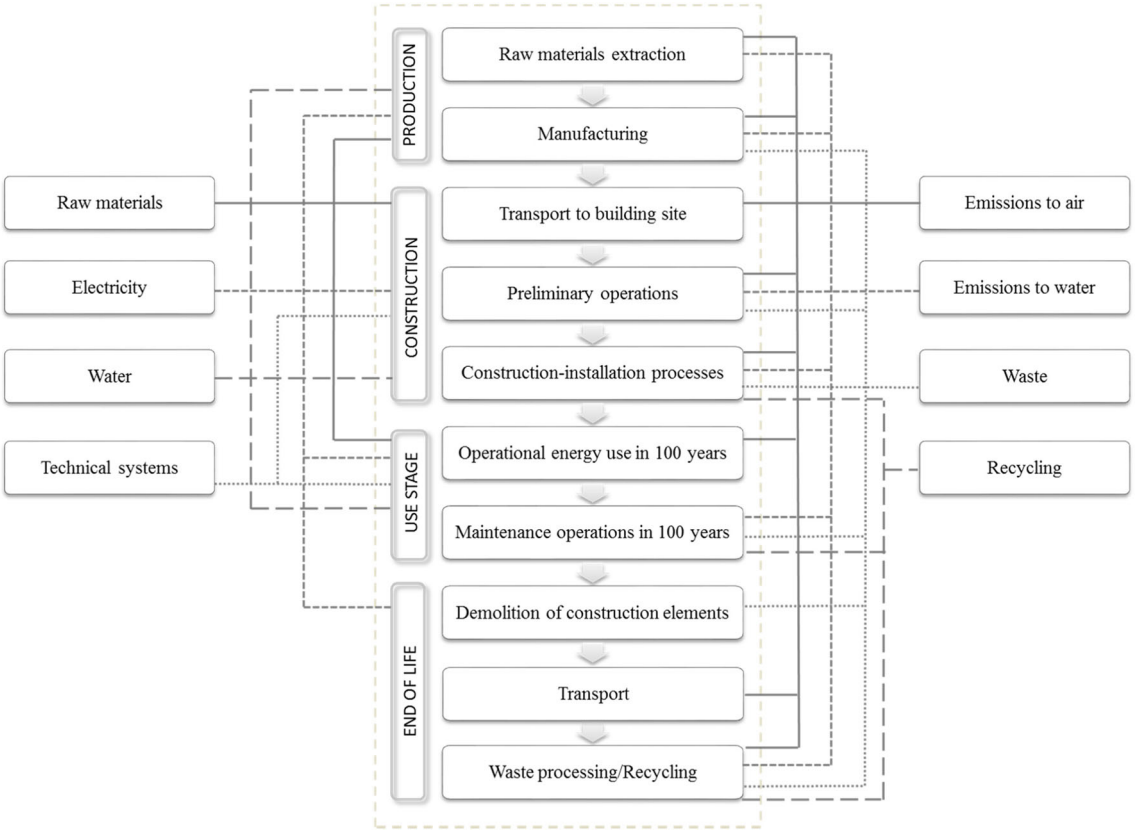

Fig. 4 System boundaries of the process related to the restoration of the fortress

The system boundaries include (Fig. 4) four main stages, in accordance with the European Standard EN 15978: 2011 "sustainability of construction works–assessment of environmental performance of buildings–calculation method." These are (i) production, (ii) construction process, (iii), use and (iv) end of life stages. These phases encompass the extraction of materials, the manufacture of components and technological elements used for the restoration, the transport from the suppliers to the building site, the energy consumption due to the recovery operations, and the buildings used. The components used in all life cycle stages and all energy consumption relating to the use phase of the restored building over the next 100 years were also considered. Materials recovered for maintenance and their final disposal were included in the system boundaries.

The system boundaries do not include the existing building and all restoration and rehabilitation operations carried out before 2001 or the new service building.

2.2.3 Data quality and impact assessment method

Primary data from throughout the restoration process, including data of new building materials and components, thermal and electric plants and construction waste were collected, both directly from Uncastillo Foundation and from the scientific literature (secondary data). The material needs of the use phase were assessed by estimating replacement and refurbishment requirements for the building parts and components over the considered lifetime of the Uncastillo Fortress. Data related to the end of life of the materials were derived from the literature. Where data were missing, the study was completed using secondary data obtained from the Ecoinvent database v3 (Kellenberger et al. 2007; Moreno Ruiz et al. 2013) to model the background processes (land use, materials production, fuel and electricity production, and transport).

A life cycle inventory (LCI) was created, taking into account resources, energy consumption, and environmental emissions as the inputs and outputs.

The analysis was conducted using SimaPro 8.0.2 software (Humbert et al. 2012; Pré Sustainability 2014a, b) and the IMPACT 2002+ evaluation method (Jolliet et al. 2003), which was modified to describe the system in a more representative manner, such as modifying the *land use* and *mineral extraction* categories and adding the *radioactive waste* category (Ferrari et al. 2015).

2.2.4 Life cycle inventory

For the functional unit, the consumption of raw materials and energy, emissions to air and water, and the treatment of the end of life of components were considered.

The process of the restoration of the complex was divided into three macroprocesses:

- Arrangement of the access
- Restoration of the Homenaje Tower
- Restoration of the Pedro IV Palace

The details of the operations considered in these processes are described in the Electronic supplementary material.

All processes consider the transport of raw materials, the transport from the company that produces the semifinished products to the company that assembles them and the transport to the construction site. A range of 100 km was considered when primary data were not available.

For the use stage, the processes relating to maintenance and consumptions were considered. The elements that are expected to be replaced during the assumed life span were considered, in terms of the number of times they will be replaced, together with their end of life treatment. Periodic repainting and cleaning were also taken into account. The consumption of the building relates to the thermal energy required for heating and the electricity needed for lighting and the equipment in the museum. Processes of recycling and reuse were assumed for the end of life of the elements when possible. The stone masonry was assumed to have a lifespan that extends beyond the 100-year lifespan, so it was not considered in the end of life process.

Table 1 shows the input data for the production and construction phase of the restoration of the whole complex, while Tables 2 and 3 report data related to the elements replaced during the life span of the Pedro Palace and of the Homenaje Tower.

Table 1 Input data for environmental LCA related to the construction phase of the whole process "fortress"

Material	Quantity	Unit
Concrete, normal	81.736	ton
Concrete, sole plate and foundation	23.890	ton
Sand	1.892	ton
Gravel, crushed	26.650	ton
Reinforcing steel	2.356	ton
Steel, unalloyed	11.765	ton
Natural stone plate, polished	31.081	ton
Cement mortar	15.372	ton
Cover plaster, mineral	1.210	ton
Brick	8.776	ton
Ceramic tile	1.311	ton
Sawnwood, hardwood, air/kiln dried, planed	0.479	ton
Sawnwood, softwood, kiln dried, planed	0.527	ton
Plywood, for indoor use	46.200	kg
Flat glass, coated	1.318	ton
Copper	0.703	ton
Bitumen adhesive compound, hot	0.895	ton
Polyvinylchloride, bulk polymerized	53.988	kg
Polyethylene, high density, granulate	104.803	kg
Polycarbonate	45.890	kg
Printed paper	1.350	kg
Door, inner, wood	15.090	m^2
Alkyd paint, white, without water, in 60% solution state	368.104	m^2
Acrylic varnish, without water, in 87.5% solution state	212.400	m^2
Computer, laptop	6	p
LCD flat screen, 17 in.	4	p
LED lamp 65.52 W	24	p

2.3 Evaluation of social aspects

Many publications have provided general classifications of the issues to be considered in a social impact assessment (SIA), which can be defined as "the process of identifying the future consequences of a current or proposed action which are related to individuals, organizations and social macro-systems" (Becker 2001).

Social impacts were defined in 1995 by the Interorganizational Committee on Guidelines and Principles for Social Impact Assessment as "the consequences to human populations of any public or private actions-that alter the ways in which people live, work, play, relate to one another, organize to meet their needs, and generally cope as members of society" (Guidelines IC 1995).

Since 1996. many studies have proposed the evaluation of social aspects through an approach that considers the entire life cycle of products, raising important issues that must still be explored (Benoît et al. 2010).

The Guidelines for Social Life Cycle Assessment of Products developed by the UNEP/SETAC in 2009, and the Handbook for Product Social Impact Assessment, developed by Pré Sustainability (Fontes 2014) draw on previous experiences and define S-LCA, proposing a reference framework for the analysis. S-LCA is defined as a methodology to assess the implications of a system-product in terms of its impact on the quality of work and life of people during its life cycle.

The basic concept of these documents is that every stage of a product or service life cycle takes place in a geographic location that generates material and energy flows, but also has social effects on the stakeholders. The stakeholder groups involved in the process are identified, together with the social issues connected with them and the indicators necessary to assess these issues.

The UNEP/SETAC guidelines identify five categories of stakeholders: workers, local communities, consumers, society, and actors in the value chain. Social issues can then be defined

Table 2 Input data for environmental LCA related to the elements replaced during the life span of the Pedro Palace

Elements	End of life	Quantity	Unit
Spiral staircase	Steel recycling	1087.192	kg
Skylight	Steel recycling	73.210	kg
	Polycarbonate recycling	45.891	kg
Gate	Steel recycling	39.160	kg
Tower crane	Steel recycling	996	kg
Scaffolds	Steel recycling	3120	kg
Vaults	Reinforced concrete recycling	26,550	kg
	Plaster disposal	1210	kg
Woodwork	Wood recycling	1.090	m^3
Roof	Incineration of bituminous membrane	604.801	kg
	Recycling of concrete and mortar	12.273	kg
	Reinforced concrete recycling	8467	kg
	Steel recycling	424.940	kg
	Sandstone reuse	7010	kg
Masonry	Brick recycling	8176	kg
Radiant floor	Sandstone reuse	9406.771	kg
	Recycling cement and sand mortar	3817.240	kg
Doors	Wood recycling	0.206	m^3
Window fixtures	Steel recycling	61.271	kg
	Glass recycling	320	kg
Electrical systems	Copper recycling	336.260	kg
	Steel recycling	6.555	kg
	PVC recycling	11.650	kg
	PE recycling	19.988	kg
	Disposal of LED lamps	90	p
Heating system	Steel recycling	0.040	kg
	Copper recycling	0.040	kg
	PVC recycling	0.128	kg
Musealization	Wood recycling	0.042	m^3
	Steel recycling	0.003	kg
	Paper recycling	0.900	kg

as impact categories and subcategories and must be assessed with appropriate indicators, which may vary depending on the context of the analysis.

UNEP/SETAC has developed a tool accompanying the guidelines, which are the "Methodological Sheets" (2013) that define categories and subcategories and suggest the inventory indicators related to them. The inventory indicators define the information to collect, which can be quantitative, qualitative, or semiquantitative, depending on the variables involved in the processes.

The "Handbook for Product Social Impact Assessment" developed by Pré Sustainability proposes a practical methodology for the evaluation of potential social impact due to the life cycle of a product, drawing on international standards and previous initiatives, primarily those described in the UNEP/SETAC guidelines. The handbook defines three categories of stakeholders: workers, consumers, and local communities. These categories are related to 19 different social issues (subcategories), such as health and safety, wages, experiences, and well-being. The social theme must be assessed through performance indicators suggested in the handbook. Indicators can be quantitative or semiquantitative. The latter are assessed based on a scale of evaluation of the performance and give a score to each indicator.

Adding the scores attributed to each performance indicator provides the "social topic score," a dimensionless number that represents the social impact of the product in relation to a particular social issue.

Social topic scores can be aggregated to obtain the "stakeholder score," a dimensionless number that represents the impact of the product on a stakeholder group. To aggregate the social topic scores, they must be multiplied by weighting factors that can be defined as a percentage of the weight assigned to the social topic score per stakeholder group.

Table 3 Input data for environmental LCA related to the elements replaced during the life span of the Homenaje Tower

Elements	End of life	Quantity	Unit
Roof	Recycling concrete and sand	9022.780	kg
	Tiles recycling	1310.9	kg
	Incineration of bituminous membrane	290.054	kg
Interior floors	Sandstone reuse	9406.770	kg
	Recycling cement and sand mortar	3817.24	kg
Skylight	Steel recycling	174.908	kg
	Glass recycling	997.5	kg
Doors	Wood recycling	0.438	m^3
Interior staircase	Wood recycling	0.255	m^3
	Steel recycling	1.214	ton
	Reinforced concrete recycling	15.75	ton
Outside staircase	Steel recycling	1298.651	kg
	Reinforced concrete recycling	5140	kg
Outside platform	Wood recycling	0.811	m^3
	Steel recycling	782.57	kg
	Reinforced concrete recycling	3000	kg
Terrace parapets	Steel recycling	545.8	kg
Electrical systems	Copper recycling	336.260	kg
	Steel recycling	6.555	kg
	PVC recycling	42.210	kg
	PE recycling	84.815	kg
	Disposal of LED lamps	126	p
Musealization	Wood recycling	0.084	m^3
	Paper recycling	0.45	kg
	LCD screen disposal	36	p
	Computer disposal	54	p

The stakeholder scores, then, can be multiplied by other weighting factors defined as percentages, and then aggregated to obtain the "Total score", a dimensionless number that represents the total social impact of a product.

The level of aggregation of results, which can be performance indicator scores, social topic scores, stakeholder group scores or one single total score, must then be chosen in accordance with the aim of the study.

The handbook specifies that the proposed social issues are only an initial list and their importance should be evaluated before starting the assessment. Their number will depend on the type and purpose of the study, considering the relevance of the topic to the subject.

The consideration of social aspects in this view is therefore strongly oriented to the evaluation of the product. The aim of this part of the study is to explore the possibility of applying these approaches and guidelines to the assessment of social aspects in interventions related to the recovery and enhancement of cultural heritage.

Starting from the key points in the illustrated reference documents, a framework has been defined that considers stakeholder, social topics, and performance indicators related to cultural heritage intervention.

The relevant aspects to consider in the social evaluation of the restoration of cultural heritage, and in the specific case study, have been assessed.

On this basis, key points were taken as stakeholder categories and social topics from the reference documents. Some were not considered, and others have been added for the specific case study. Tables 4, 5, 6, and 7 show the stakeholder groups, social topics, and performance indicators identified for the assessment of the case study. Social topics and indicators specifically created for the case study are written in italics.

For the assessment, a scaled-based approach was considered, taking as reference a score range from − 2 to + 2 suggested by the Pré Handbook, where − 2 represents a nonacceptable performance and + 2 an ideal performance. A zero score represents a performance aligned with international standards.

Scores were assigned to the performance indicators, in some cases based on the Pré Handbook criteria, and in others based on criteria specifically created for the case study. The performance indicators taken from the handbook use the handbooks' reference scales.

Table 4 Stakeholder group "workers"—social topics, performance indicators, and references for criteria selection

Stakeholder	Subgroups	Social topics	Performance indicators	References
Workers	*Workers of the museum, workers of the construction company*	Health and safety	Adequate health and safety training	Pré Sustainability (2016)
			Duty and responsibility clearly delegated. Management of health and safety policies and procedures	Pré Sustainability (2016)
			Safety of the building: evacuation plan, fire protection systems, emergency lights, fall protection	Ley 31/1995, de 8 de noviembre, de Prevención de Riesgos Laborales Real Decreto 486/1997, de 14 de abril, por el que se establecen las disposiciones mínimas de seguridad y salud en los lugares de trabajo
			Indoor air quality: devices for ventilation, adequate thermal comfort, pollutants control	Ley 31/1995, de 8 de noviembre, de Prevención de Riesgos Laborales Real Decreto 486/1997, de 14 de abril, por el que se establecen las disposiciones mínimas de seguridad y salud en los lugares de trabajo
			Presence of security plan for the construction site	Real Decreto 1627/1997, de 24 de octubre, por el que se establecen disposiciones mínimas de seguridad y salud en las obras de construcción
		Wages	Percentage of workers paid below legal wage, at legal wage, or living wage	Pré Sustainability (2016)
		Social benefits	Percentage of workers paid the social benefits or additional benefits	Pré Sustainability (2016)
		Working hours	Normal working week does not exceed legal limit	Pré Sustainability (2016)
			Overtime recorded, voluntary, compensated at premium rate, does not exceed legal limits	Pré Sustainability (2016)
		Discrimination	Workers understand how to file a complaint or raise a concern about any management action that violates the nondiscrimination policy	Pré Sustainability (2016)
			Wage slips or wage records of workers confirm equal pay for work of equal value	Pré Sustainability (2016)
			Goals for staff diversity are set and achieved	Pré Sustainability (2016)
		Freedom of association and collective bargaining	Employer does not hinder or interfere but proactively informs workers about their right to organize themselves and bargain collectively	Pré Sustainability (2016)
			No disciplinary actions taken by management against workers organizing themselves collectively	Pré Sustainability (2016)
		Employment relationship	Percentage of workers who have documented employment conditions	Pré Sustainability (2016)
			Percentage of workers who have a permanent employment relationship	Pré Sustainability (2016)
		Training and education	Percentage of workers who received training or have participated periodically in programs aimed at capacity and skill development	Pré Sustainability (2016)
		Work-life balance	Workers with direct family responsibilities are allowed to benefit from maternity protection and to take maternity, parental, or compassionate leave when needed	Pré Sustainability (2016)
			Percentage of workers that can benefit from flexible working arrangements to balance work and private life	Pré Sustainability (2016)
		Job satisfaction and engagement	Worker turnover rate during the reporting period	Pré Sustainability (2016)

Table 5 Stakeholder group "consumers"—social topics, performance indicators, and references for criteria selection

Stakeholder	Subgroups	Social topics	Performance indicators	References
Consumers	Visitors, scholars	Health and safety	Safety of the building: evacuation plan, fire protection systems, emergency lights, fall protection	Ley 31/1995, de 8 de noviembre, de Prevención de Riesgos Laborales Real Decreto 486/1997, de 14 de abril, por el que se establecen las disposiciones mínimas de seguridad y salud en los lugares de trabajo Ley 3/1997, de 7 de abril, de Promoción de la Accesibilidad y Supresión de Barreras Arquitectónicas, Urbanísticas, de Transportes y de la Comunicación de Aragon
		Well-being	Composite measure of experienced well-being	Pré Sustainability (2016)
		Cultural development	Presence of educational programs for visitors	International Council of Museums (2004)
			Free access or specific programs for researchers and scholars in the field of cultural heritage	International Council of Museums (2004)

Indicators created for the case study are described below, along with the reference scale to assign scores to them. The description refers to the affected stakeholder group. Social topics from the reference documents use indicators taken from the same documents. The life span considered for the social aspects starts from the beginning of the intervention period (2001) until the time when the study was conducted (2015).

2.3.1 Stakeholder group: workers

Social topic: health and safety The stakeholder category "workers" used in the case study includes workers in the museum and those of the construction company. Specific performance indicators were considered in addition to those suggested by the Pré Handbook, and they differ for the two subgroups.

Workers in the museum In addition to the indicators suggested by the handbook, the health and safety of workers inside the building can be measured by considering the presence of security devices, indoor air quality, and thermal comfort.

Security devices considered are evacuation plans, fire protection systems, emergency lights, fall protection, alarms, and any other measures required in Spanish law. Performance indicators and the reference scale are given in Table 8, together with the reference legislation.

Workers of the construction company The specific indicator is the presence of a security plan for the construction site in accordance with legislation. Performance indicators and the reference scale are given in Table 9.

2.3.2 Stakeholder group: consumers

In the case study, the stakeholder category "consumers" takes into account the visitors to the museum, tourists, and scholars.

Social topic: health and safety The health and safety of people inside the building can be measured by considering the presence of security devices (evacuation plan, fire protection system, emergency lights, fall protection, alarms), indoor air quality, and thermal comfort, and also the extent to which the building is safe and accessible for visitors with reduced mobility or special needs, according to the law of the Province of Aragon.

Performance indicators and the reference scale are illustrated in Table 10.

Social topic: well-being The Pré Handbook gives an indication of the measure of experienced well-being through a set of questions aimed at consumers. As with other performance indicators, the assessment depends on the availability of data, and therefore, there should be an adequate number of respondents. To evaluate this social topic, a questionnaire was defined based on the questions in the Pré Handbook, asking consumers how they felt on a scale of 0 to 10 and aggregating the results as indicated in the handbook. The handbook does not define an adequate number of responders, as this can vary extensively depending on the case study. Thus, arbitrary decisions about the number of responders were made. The latest available data provided by the Uncastillo Foundation gave a total of 6700 visitors a year (Fundaciòn Uncastillo 2011), while we considered an average of 18 visitors per day. We estimated that multiplying this number by 3 and interviewing visitors on different days and different times could give a good measure of the different visitor experiences. Thus, 54 visitors were interviewed.

Table 6 Stakeholder group "local communities"—social topics, performance indicators, and references for criteria selection

Stakeholder	Subgroups	Social topics	Performance indicators	References
Local communities	*Citizens*	Health and safety	Risks and impacts on community health and safety are regularly assessed and monitored.	Pré Sustainability (2016)
			Appropriate measures to prevent or mitigate adverse impacts on community health and safety are implemented.	Pré Sustainability (2016)
			Proactive actions to improve community health and safety are taken.	Pré Sustainability (2016)
		Access to tangible resources	Appropriate measures to prevent or mitigate adverse impacts or to restore community access to tangible resources are implemented.	Pré Sustainability (2016)
			Proactive actions to improve community access to tangible resources are taken.	Pré Sustainability (2016)
		Local capacity building	Programs to build human capacities of community members through general community education initiatives and/or formal programs	Pré Sustainability (2016)
		Community involvement	Definition and regular utilization of appropriate communications channels between the foundation and the local community	Pré Sustainability (2016)
			Opportunities for community support are identified and appropriate programs are implemented.	Pré Sustainability (2016)
		Employment	Number of new jobs created during the reporting period	Pré Sustainability (2016)
			Number of new jobs lost during the reporting period	Pré Sustainability (2016)
		Well-being	*The restored building has an impact on physiological needs satisfaction*	Maslow (1943)
			The restored building has an impact on satisfaction of the need of safety and protection	Maslow (1943)
			The restored building has an impact on satisfaction of the need of belonging	Maslow (1943)
			The restored building has an impact on satisfaction of the need of self-esteem.	Maslow (1943)
			The restored building has an impact on satisfaction of the need of self-actualization.	Maslow (1943)

Table 7 Stakeholder group "society"—social topics, performance indicators, and references for criteria selection

Stakeholder	Subgroups	Social topics	Performance indicators	References
Society	*Public administration, private institutions, private companies, state*	*Involvement*	*Involvement of the municipality in the management of the complex*	Council of Europe (2005)
			Involvement of the province in the management of the complex	Council of Europe (2005)
			Involvement of the region in the management of the complex	Council of Europe (2005)
			Involvement of cultural organization in the management of the complex	Council of Europe (2005)
			Involvement of private companies in the management of the complex	Council of Europe (2005)
			Involvement of individuals in the management of the complex	Council of Europe (2005)
		Cultural value	*The complex is included in the register of cultural goods (and at which level).*	Ley 16/1985, de 25 de junio, del Patrimonio Histórico Español

Table 8 Performance indicators and reference scale related to health and safety for the workers of the museum

+ 2	Duties and lines of responsibility for health and safety are defined. Workers are involved in the development of health and safety programs. All the security devices are present and the building is safe and accessible independently by workers with reduced mobility or sensory capacity, without the intervention of special help. Indoor air quality and thermal comfort are above the standard.
+ 1	Duties and lines of responsibility for health and safety are defined. Workers are involved in the development of health and safety programs. All the security devices are present and the building is safe and accessible by workers with reduced mobility or sensory capacity, using special assistance. Indoor air quality and thermal comfort are above the standard.
0	Duties and lines of responsibility for health and safety are defined. All the security devices are present and the building is safe and accessible by workers with reduced mobility or sensory capacity, using special assistance. Indoor air quality and thermal comfort meet minimum standards.
− 1	No duties and lines of responsibility for health and safety are defined. All the security devices are present. The building is not completely accessible by workers with reduced mobility or sensory capacity and/or indoor air quality and thermal comfort are below the minimum standard.
− 2	Duties and lines of responsibility for health and safety are defined. Workers are involved in the development of health and safety programs. All the security devices are present and the building is safe and accessible independently by workers with reduced mobility or sensory capacity, without the intervention of special help. Indoor air quality and thermal comfort are above the standard.

Social topic: cultural development According to the International Council of Museums (ICOM) Statutes, adopted by the 22nd General Assembly in Vienna, Austria on August 24th, 2007: "A museum is a non-profit, permanent institution in the service of society and its development, open to the public, which acquires, conserves, researches, communicates and exhibits the tangible and intangible heritage of humanity and its environment for the purposes of education, study and enjoyment". The ICOM Code of Ethics for Museums (2007) presents a minimum standard for museums, through a series of principles supported by guidelines for desirable professional practice. The document states that museums have a duty to develop their educational role and attract wider audiences. The contribution of the function of the complex to the cultural development of the visitors should thus be considered. A neutral value (zero) is attributed when the museum performs its function without adding extra activities or initiatives to further promote cultural development, and a score is given when this added value is evident.

The indicators can be the presence of periodical educational programs for visitors and the possibility of free access for scholars to the museum and to the goods and information it contains. Performance indicators and the reference scale are given in Table 11.

Negative scores are not indicated because it is assumed the intervention cannot negatively affect cultural development.

2.3.3 Stakeholder group: local communities

Social topic: well-being In Section 1 (the Introduction), the link between the restoration of cultural heritage and sustainable development is described, highlighting how historical places are an expression of the culture and values of the local societies. Therefore, the social issue "well-being" was considered appropriate for evaluation within the stakeholder group of the local community.

The set of questions to assess the social issue of well-being in the consumer category did not appear appropriate for

Table 9 Performance indicators and reference scale related to health and safety for the workers of the construction company

+ 2	Health and safety training is provided and duty and lines of responsibility for health and safety are defined. The level of incidents is measured and reduction targets are set. Security plan for the construction site is well detailed and easily accessible to all the workers, and safety devices in the construction site are above the standards.
+ 1	Health and safety training is provided and duty and lines of responsibility for health and safety are defined. Security plan for the construction site is well detailed and easily accessible to all the workers, and safety devices in the construction site are above the standards.
0	Health and safety training is provided and duty and lines of responsibility for health and safety are defined. Security plan for the construction site is present. Safety devices in the construction site meet the standards.
− 1	No health and safety training is provided or no duty and lines of responsibility for health and safety are defined. Security plan for the construction site is not present or safety devices in the construction site do not meet the standards.
− 2	No health and safety training is provided and no duty and lines of responsibility for health and safety are defined. Security plan for the construction site is not present and safety devices in the construction site do not meet the standards.

Table 10 Performance indicators and reference scale related to health and safety for the consumers

+ 2	All the security devices are present and the building is safe and accessible independently by visitors with reduced mobility or sensory, without the intervention of special help. Indoor air quality and thermal comfort are above the standard.
+ 1	All the security devices are present and the building is safe and accessible by visitors with reduced mobility or sensory capacity using special assistance. Indoor air quality and thermal comfort are above the standard.
0	All the security devices are present and the building is safe and accessible by visitors with reduced mobility or sensory capacity using special assistance. Indoor air quality and thermal comfort meet minimum standards.
− 1	All the security devices are present. The building is not completely accessible by visitors with reduced mobility or sensory capacity, and/or indoor air quality and thermal comfort are below the minimum standard.
− 2	Not all the security devices are present. The building is not completely accessible by visitors with reduced mobility or sensory capacity, and/or indoor air quality and thermal comfort are below the minimum standard.

evaluating the same social issue in the local community category, as well-being related to the restoration of the fortress has different implications for the two stakeholder categories. For consumers, the experience is temporary and short-lived and represents an immediate satisfaction of needs. The impact on local community well-being, however, lasts over time and therefore requires different evaluation criteria.

A subjective assessment was thus made, based on any contribution that the restored fortress makes to the satisfaction of needs and individual self-realization in the local community. Maslow's hierarchy of needs was taken as reference. This is a psychological theory proposed by Abraham Maslow in 1943, which remains a popular framework in sociology research, management training, and secondary and higher psychology instruction. The theory states that people are motivated to fulfill certain needs. When one need is fulfilled, the individual seeks to meet the next, and so on. It identifies five motivational needs, often depicted as hierarchical levels within a pyramid (Fig. 5):

1. Biological and physiological needs: air, food, drink, shelter, warmth, sex, and sleep
2. Safety needs: protection from the elements, security, order, law, stability, and freedom from fear
3. Love and belongingness needs: friendship, intimacy, affection and love, from a work group, family, friends, or romantic relationships
4. Esteem needs: achievement, mastery, independence, status, dominance, prestige, self-respect, and respect from others
5. Self-actualization needs: realizing personal potential, self-fulfillment, seeking personal growth, and peak experiences

This theory can be taken as reference for the assessment of the well-being of the local community resulting from the fortress restoration. For example, the enhancement of the cultural heritage of the territory can positively affect the need of belongingness in the citizens.

The performance indicators and the reference scale are given in Table 12.

Table 11 Performance indicators and reference scale related the cultural development for the consumers

+ 2	A calendar with periodical educational program is set, and scholars have free access to the museum.
+ 1	Educational events take place but not periodically, and scholars have free access.
0	Educational programs do not take place, and scholars have not free access.

2.3.4 Stakeholder group: society

According to the ICOM definition, a museum is an institution in the service of society, promoting its education and cultural development. Therefore, it is not only the local community that is affected by the museum's activities, society as a whole should be considered among the stakeholders involved.

Social topic: involvement The participative process of cultural heritage enhancement, based on the synergy between public institutions and private organizations, is regarded by the Faro Convention as the key to increasing European citizens' awareness of the value of cultural heritage and its contribution to well-being and quality of life.

Therefore, the level of involvement of public institutions and private organizations or citizens is considered and the number of private and public actors involved in the restoration work and in the realization and management of the museum taken as an indicator to assess this social issue.

Performance indicators and the reference scale are given in Table 13.

Social topic: cultural value In Section 1, it was demonstrated that a basic concept of the Faro Convention is that the preservation of cultural heritage, and its sustainable management contributes to human development and life quality

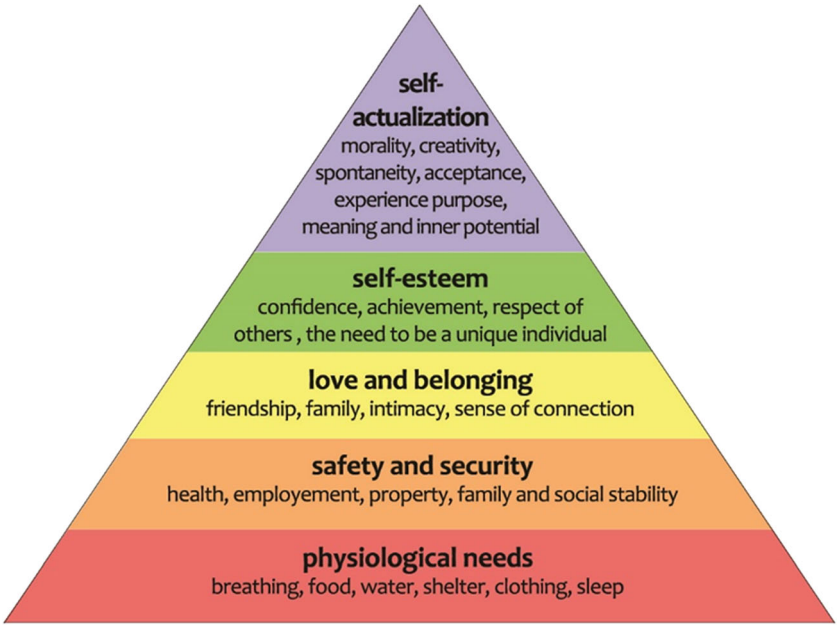

Fig. 5 Maslow's hierarchy of needs

(Carmosino 2013). The built environment has value as a testimony of civilization, resulting from the dynamic evolution of the relationship between man and nature (Golinelli 2016). Therefore, the cultural value of the building and the benefits to the society derived from its conservation and enhancement must be considered.

The Spanish Department of Fine Arts and Cultural Assets and Archives and Libraries is responsible for maintaining and updating the General Register of Goods of Cultural Interest and the General Inventory of Personal Property, as defined in Spanish legislation. In this register, information is collected about goods that have a level of protection from the State. Within the overall system there are three levels of protection, depending on the specific importance of the goods. Ordered from least to most, the levels of protection are:

- Spanish historical heritage
- General inventory of personal property
- Goods of cultural interests

Table 12 Performance indicators and reference scale related to the well-being for the local community

+ 2	Visiting the complex has an impact on 2 or more of the indicated needs.
+ 1	Visiting the complex has an impact on 1 of the indicated needs.
0	Visiting the complex has no impact on the indicated needs.
− 1	Visiting the complex has a negative impact on 1 of the indicated needs.
− 2	Visiting the complex has a negative impact on 2 or more of the indicated needs.

It is assumed that the greater the degree of protection, the greater the cultural value of the goods. The performance indicators and the reference scale are given in Table 14.

When a stakeholder group contains subcategories (for example, workers of the museum and workers of the construction company), an average score is calculated.

3 Results and discussion

3.1 Environmental analysis

In the first part of the analysis, a midpoint category assessment was conducted on the whole complex, to identify which of the three macroprocesses had the most impact. In the second part, the

Table 13 Performance indicators and reference scale related to the involvement for the society

+ 2	The municipality, the province, the region, cultural organizations, private companies, or individuals are involved in the management of the complex.
+ 1	The municipality, the province, the region, and cultural organizations are involved in the management of the complex.
0	The municipality, the province, and cultural organizations are involved in the management of the complex.
− 1	The municipality and cultural organizations are involved in the management of the complex.
−2	Only the municipality is involved in the management of the complex.

Table 14 Performance indicators and reference scale related to the cultural value for the society

+ 2	The complex is registered as "goods of cultural interests."
+ 1	The complex is registered as "Spanish historical heritage" or "general inventory of personal property."
0	No protection is established on the complex.
− 1	The complex is registered as "Spanish historical heritage" or "general inventory of personal property" and the intervention has damaged it.
− 2	The complex is registered as "goods of cultural interests" and the intervention has damaged it.

macroprocesses with the most impact were analyzed separately. The categories considered are those listed in Table 15, with respect to the assessment of the whole complex of the fortress.

The process with the most impact is that of the restoration of Pedro Palace, which generates 78.81% of the environmental impact, and is shown in Fig. 6. The Homenaje Tower restoration generates 20.09% of the total impact, while 3.11% is generated by access arrangements.

Figure 7 and Table 16 highlight that the most significant contribution to the total damage is due to the respiratory inorganics impact category (47.15%), mainly due to the use of sandstone in the restoration of Pedro Palace, which has the most impact. The second main contributor to the total environmental impact is the global warming category (25.24%), mainly due to 96.03% of carbon dioxide emissions from the fossil fuels consumed in the cement clinker production used in the restoration of Pedro Palace. The nonrenewable energy impact category has a significant environmental load (19.03%) due to the consumption of hard coal at 29.84%, and natural gas at 29.09%, in the energy supply processes and the electricity distribution network used in the restoration of Pedro Palace.

The endpoint analysis demonstrates that the total damage is made up of 51.49% from the human health category, 25.24% from climate change, 19.24% from resources, and 4.03% from the ecosystem quality category. The Pedro Palace restoration has the main effect on all the damage categories considered and therefore was analyzed separately.

Most of the environmental impact was found to be related to the masonry process, which generates 80.14% of the impact. Within the masonry processes of the palace, the construction of external walls results in the greatest environmental burden (96.39%), mainly due to the use of sandstone. The external walls consist of a core wall 1.5 m thick, covered with two outer layers of sandstone and filled with cyclopean concrete, a mix of cement and sandstone pieces. Therefore, sandstone is widely used with a total amount of 386 tons, which generates 77.26% of the total impact related to the palace and 59.34% of the impact related to the whole fortress complex.

The impact category most affected by the external wall construction is respiratory inorganics, with 50.24% attributed to this process. This is due mainly to particulate emission during the working processes of the sandstone, in particular to the surface polishing process. The inventory shows an emission of 365.89 kg of particulates < 2.5 μm attributed to external walls, and 32% of these particulates is due to the production of the smooth stone used for the external faces of the core wall.

The environmental burden of the use phase in the Pedro Palace is lower than that of the construction phase. The energy consumption is very low due to the installation of highly

Table 15 Impact assessment by impact categories related to the life cycle of the whole complex of the fortress

Impact category	Unit	Total	Access arrangement	Tower restoration	Palace restoration
Total	Pt	297.91	9.25	59.84	228..82
Carcinogens	Pt	6.355	3.59%	27.18%	69.23%
Noncarcinogens	Pt	6.183	2.01%	42.72%	55.27%
Respiratory inorganics	Pt	140.465	3.26%	17.49%	79.25%
Ionizing radiation	Pt	0.308	2.79%	24.51%	72.69%
Ozone layer depletion	Pt	0.009	1.46%	16.40%	82.14%
Respiratory organics	Pt	0.078	3.53%	25.64%	70.83%
Aquatic ecotoxicity	Pt	0.178	2.08%	46.51%	51.41%
Terrestrial ecotoxicity	Pt	8.031	3.56%	41.74%	54.70%
Terrestrial acid/nutri	Pt	1.209	3.29%	18.25%	78.46%
Land occupation	Pt	2.585	3.71%	38.41%	57.88%
Aquatic acidification	Pt	0.000	0	0	0
Aquatic eutrophication	Pt	0.000	0	0	0
Global warming	Pt	75.192	2.77%	17.07%	80.17%
Nonrenewable energy	Pt	56.705	3.09%	22.91%	74.01%
Mineral extraction	Pt	0.610	9.86%	53.92%	36.22%

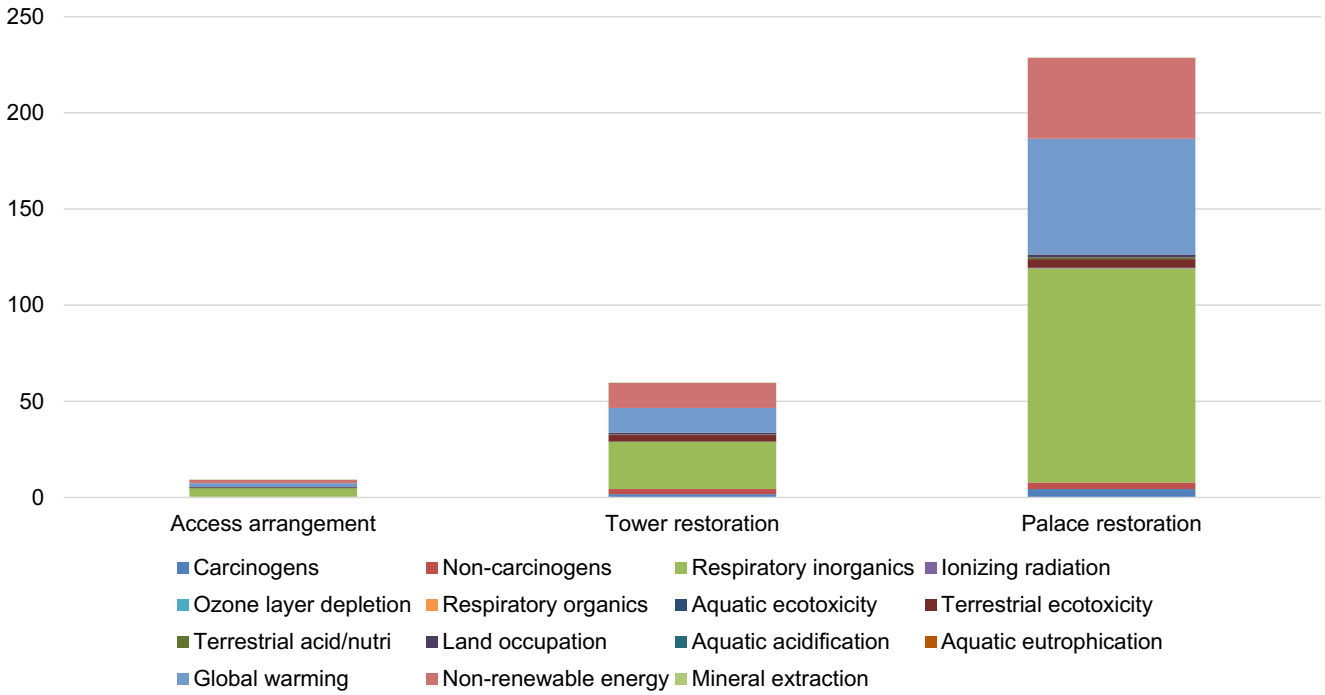

Fig. 6 Evaluation by a single score of the restoration of the whole complex of Uncastillo Fortress (IMPACT 2002+ method)

efficient heating and lighting systems. However, the construction phase generates the most significant impact over the entire life of the building, due to the production of materials and their embodied energy.

Conversely, the LCA analysis of the Homenaje Tower reveals that the greatest impact is mainly in the use phase, primarily in the process related to maintenance, which generates 44.33% of the environmental burden. Within the maintenance process, the periodic replacement of the museum equipment elements generates the greatest impact, such as the illustrative panels, furnishings, and computers. The total proportion of the impact caused by maintenance is 32.98%. In terms of museum equipment, 56.87% of the impact is due to the use and replacement every 10 years of liquid crystal screens, which contain raw materials and involve production processes that have a high impact and mostly affect the respiratory inorganics category.

The difference between the results of the two buildings highlights that in the restoration of cultural heritage buildings, each case may be very different and can depend on the materials used and the condition of the buildings. Conducting an environmental LCA is thus fundamental, to gain initial knowledge of the conservation status of the existing buildings and help to decide the best intervention strategies.

3.2 Social aspects

As recommended in the Handbook methodology, the level of aggregation of results for the assessment of social aspects was chosen in accordance with the aim of the study and the application context. The aim of this part of the study is to explore the possibility of adapting the approaches and guidelines for the social assessment of products to the assessment of social aspects in interventions related to the recovery and enhancement of cultural heritage. Aggregating the score at the "social topic level" was considered the adequate level for this assessment, as this is an exploratory study. As suggested in the Handbook, presenting only the performance indicator can be confusing for nonexperts. Shifting to a "stakeholder score level" can, however, result in the loss of details regarding social topics, which are important in this study, and this is more oriented toward the evaluation of the methodology than of the "product." Furthermore, aggregation at the stakeholder level and the total score level requires the definition of weighing factors, which was considered premature at this stage in the study.

The social topic scores were calculated by aggregating performance indicators. The first step was the attribution of a score to each actor or each element considered for each performance indicator, following the criteria illustrated in Section 2.3. The scores related to different actors or elements were aggregated to calculate the performance indicators. The performance indicators were divided by the number of actors to generate average social topic scores, to avoid these scores being influenced by the number of actors supplying information.

From the assessment, a social topic score for each topic was obtained. This final score enables the advantages (or disadvantages) that the intervention makes on social issues to be determined, related to different stakeholders. The results are given in Table 17 and indicate that the restoration of the fortress, along with its sustainable management, generates

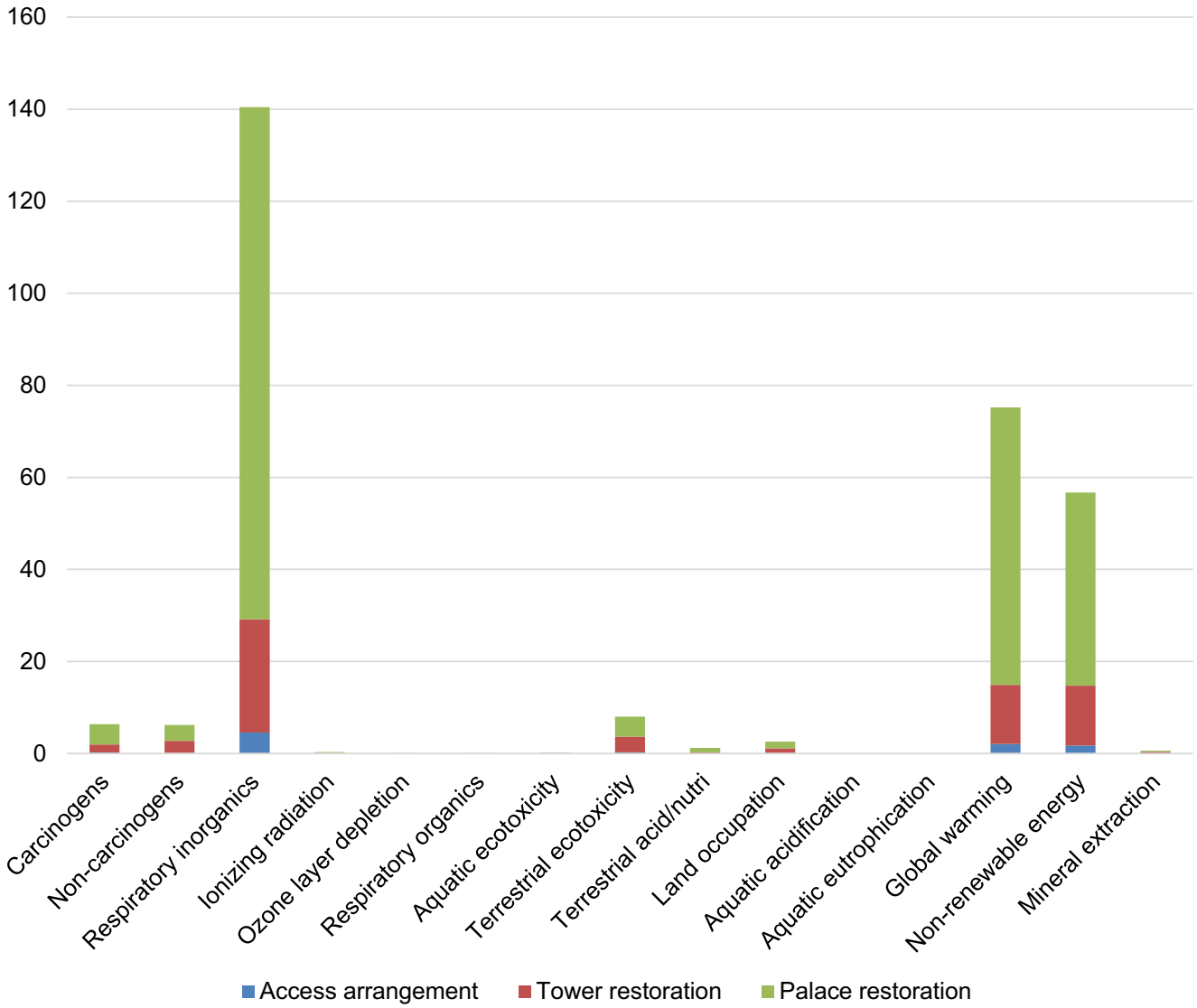

Fig. 7 Evaluation by impact categories of the restoration of the whole complex of Uncastillo Fortress (IMPACT 2002+ method)

positive social impact, particularly on the stakeholder category of local community and society. In fact, the highest scores are attributed to the social themes related to this category, due to the creation of employment, the educational function of the building, and to it being historical evidence and a point of cultural identification for the population.

Access to tangible resources for the local community, local capacity building, and community involvement are objectives already within the concept of the intervention. This demonstrates that tangible and intangible heritage for education purposes is the main function of a museum, and preservation of historical heritage results in the conservation of historical values and the evidence they represent for the local community. For these social topics, the results indicate that these objectives have thus been achieved.

The social topic related to employment had the highest score and is based on the number of jobs created during the construction phase and for the management of the museum. In accordance with the Handbook, the score was calculated by considering the number of new jobs created and that the number of jobs created is greater than the number of jobs lost (no jobs were lost).

The well-being of the local community was assessed during a meeting with the community at Uncastillo, where the study was presented and a debate took place. The views of the participants could then be interpreted, regarding their degree of satisfaction with the restoration and implementation of the museum.

The result for the well-being topic in the stakeholder category of consumers was still positive, but lower than that related to the local community. The answers to the questionnaire distributed to visitors indicated high results regarding the general feeling of happiness and comfort when visiting the fortress, but "neutral" results were obtained regarding feelings of

Table 16 Impact assessment by impact categories related to the life cycle of Pedro Palace

Impact category	Unit	Total	Preliminary operations	Spiral staircase	Skylight	Gate	Vaults	Woodwork	Roof
Total	Pt	2.29E+02	2.32E+00	1.98E+00	8.09E-01	5.61E-02	2.05E+00	4.14E-01	7.69E+00
Carcinogens	Pt	4.40E+00	1.16E-01	9.94E-02	4.00E-02	2.12E-03	2.94E-02	5.61E-03	1.81E-01
Noncarcinogens	Pt	3.42E+00	8.68E-02	1.67E-01	1.79E-02	3.58E-03	2.59E-02	9.36E-03	3.64E-01
Respiratory inorganics	Pt	1.11E+02	1.08E+00	8.70E-01	3.11E-01	2.71E-02	9.86E-01	1.39E-01	3.83E+00
Ionizing radiation	Pt	2.24E-01	1.36E-03	6.91E-04	2.34E-04	1.49E-05	1.37E-03	3.87E-04	5.45E-03
Ozone layer depletion	Pt	7.59E-03	3.47E-05	2.34E-05	5.15E-06	6.81E-07	2.62E-05	8.01E-06	1.06E-04
Respiratory organics	Pt	5.53E-02	1.09E-03	7.98E-04	2.52E-04	3.00E-05	5.33E-04	2.28E-04	2.16E-03
Aquatic ecotoxicity	Pt	9.14E-02	1.43E-03	1.89E-03	3.14E-04	3.79E-05	7.00E-04	5.76E-04	4.34E-03
Terrestrial ecotoxicity	Pt	4.39E+00	1.05E-01	1.92E-01	3.67E-02	3.54E-03	3.43E-02	3.33E-02	4.40E-01
Terrestrial acid/nutri	Pt	9.49E-01	7.78E-03	5.38E-03	2.23E-03	1.48E-04	9.78E-03	1.62E-03	2.67E-02
Land occupation	Pt	1.50E+00	1.44E-02	2.50E-02	4.19E-03	5.44E-04	1.20E-02	7.33E-02	4.07E-02
Aquatic acidification	Pt	0	0	0	0	0	0	0	0
Aquatic eutrophication	Pt	0	0	0	0	0	0	0	0
Global warming	Pt	6.03E+01	4.94E-01	3.51E-01	1.90E-01	1.14E-02	6.10E-01	7.56E-02	1.49E+00
Nonrenewable energy	Pt	4.20E+01	4.05E-01	2.53E-01	1.96E-01	7.36E-03	3.42E-01	7.41E-02	1.29E+00
Mineral extraction	Pt	2.21E-01	1.29E-02	1.38E-02	9.88E-03	1.65E-04	8.27E-04	2.51E-04	1.47E-02

Impact category	Masonry	Radiant floor	Window fixtures	Electrical system	Heating system	Museum	Maintenance	Energy	End of life
Total	1.83E+02	6.41E+00	8.40E-01	4.13E-01	7.68E-04	2.95E-02	1.67E+01	6.89E+00	−1.19E+00
Carcinogens	3.16E+00	1.05E-01	2.99E-02	1.37E-02	1.99E-05	9.83E-04	4.67E-01	1.77E-01	−2.81E-02
Noncarcinogens	1.89E+00	1.10E-01	3.16E-02	5.85E-02	1.20E-04	5.91E-04	5.75E-01	6.05E-02	1.81E-02
Respiratory inorganics	9.28E+01	3.43E+00	3.39E-01	1.61E-01	2.98E-04	9.79E-03	6.30E+00	1.88E+00	−8.00E-01
Ionizing radiation	1.71E-01	5.11E-03	5.51E-04	1.61E-04	2.57E-07	2.37E-05	1.01E-02	2.94E-02	−2.01E-03
Ozone layer depletion	2.30E-03	1.51E-03	1.65E-05	9.74E-06	1.65E-08	5.40E-07	3.19E-03	3.73E-04	−1.28E-05
Respiratory organics	4.12E-02	1.58E-03	2.96E-04	1.15E-04	2.52E-07	1.37E-05	6.11E-03	9.80E-04	−3.41E-05
Aquatic ecotoxicity	5.39E-02	2.60E-03	1.52E-03	9.17E-04	1.87E-06	2.37E-05	1.93E-02	4.05E-03	−2.41E-04
Terrestrial ecotoxicity	2.38E+00	1.50E-01	5.14E-02	5.64E-02	1.23E-04	1.21E-03	7.51E-01	1.69E-01	−7.96E-03
Terrestrial acid/nutri	7.80E-01	2.59E-02	3.31E-03	1.33E-03	2.59E-06	1.02E-04	6.35E-02	2.53E-02	−4.04E-03
Land occupation	8.85E-01	3.80E-02	1.94E-02	4.86E-03	5.33E-06	2.85E-03	2.81E-01	9.89E-02	−4.04E-03
Aquatic acidification	0	0	0	0	0	0	0	0	0
Aquatic eutrophication	0	0	0	0	0	0	0	0	0
Global warming	4.93E+01	1.46E+00	1.75E-01	5.78E-02	7.71E-05	7.16E-03	4.26E+00	1.90E+00	−1.08E-01
Nonrenewable energy	3.19E+01	1.08E+00	1.79E-01	5.03E-02	1.03E-04	6.72E-03	3.86E+00	2.54E+00	−2.51E-01
Mineral extraction	3.76E-02	8.93E-03	8.92E-03	7.53E-03	1.63E-05	6.48E-05	9.99E-02	4.45E-03	8.70E-04

Table 17 Social topics score results

Stakeholder	Social Topics	-2	-1	0	1	2
Workers	Health and safety					
	Wages					
	Social benefits					
	Working hours					
	Discrimination					
	Freedom of association and collective bargaining					
	Employment relationship					
	Training and education					
	Work-life balance					
	Job satisfaction and engagement					
Consumers	Health and safety					
	Well being					
	Cultural development					
Local communities	Health and safety					
	Access to tangible resources					
	Local capacity building					
	Community involvment					
	Employment					
	Well being					
Society	Engagement					
	Cultural value					

self-esteem, pride, and sense of connection. The sensations expressed by the local community, however, produced positive results with regard to these sensations. This highlights that interventions of this type bring maximum benefit to the local community, in terms of the well-being experienced.

The results for the social topic of "engagement" related to society took into account the private/public partnership in the creation of the Uncastillo Foundation and the involvement of the municipality of Uncastillo, the provincial administration of Saragossa, the Government of Aragon, private companies, and individuals. The social topic "cultural value" takes into account the fact that the fortress is registered as "goods of cultural interests" in the General Register of Goods of Cultural Interest and in the General Inventory of Personal Property of Spain, which offers the greatest degree of protection.

Social topics scores related to the workers category range between 0 and 1 and, thus, indicate performances that are in line with or just above the legal standards. If the management of the building site and the museum aimed to go far beyond the standard requirements, this would lead to higher scores even in the workers category and, therefore, to a higher overall score. The intervention would thus bring social benefits in a wider sense.

4 Conclusions

The aim of this study was to explore the suitability of an approach based on the life cycle assessment methodology to evaluate the potential of cultural heritage as a promoter of sustainable development.

The case study has proven suitable for this research, because of the objective of the Uncastillo Foundation, which promoted the intervention. The objective is to contribute to the conservation and enhancement of the cultural heritage of Uncastillo through interventions that could bring social development, generate wealth, and improve the living conditions of the inhabitants of the territory. Therefore, some benefits related to the intervention are already within the project concept. The application of the defined framework can also help verify the project objectives.

With regard to the environmental aspects, the analysis highlighted the most processes with the most impact related to the life cycle of the intervention, using a 100-year time reference. The greatest impact was due to the macroprocesses of the Palace of Pedro IV, generated by the restoration of the sandstone walls, making up about 49% of the damage in the restoration of the whole complex of the fortress.

The analysis related to the Homenaje Tower highlights that the impact is due mainly to the use phase and primarily for the process related to maintenance, which generates 44.33% of the environmental burden of the tower process, due to the periodic replacement of some of the museum's devices.

The difference in these results outlines that performing an environmental LCA on cultural heritage intervention can give a prior knowledge of the specific situation of the building or monument and help to decide the best intervention strategies.

The framework developed from S-LCA guidelines and the Pré Handbook outlines the advantages of intervention in terms of social issues related to different stakeholders. The stakeholder categories affected by the most positive impact were the local community and the society, which is related to the benefits from the intervention being already within the project idea. Therefore, the framework can be considered a suitable tool for the evaluation of social aspects related to the interventions on cultural heritage. The instrument should, however, be adapted to the context and to the reference case study, and necessary changes to performance indicators, social themes, and stakeholder categories should be made.

Many questions still remain to be explored in the field of S-LCA, such as determining the implications that affect the system boundary definition when a social impact assessment is included in an LCA study.

The debate on the environmental, social, and economic values of cultural heritage has continued in recent years and involves a large number of stakeholders such as communities, policy makers, businesses, and heritage professionals. The Uncastillo Fortress restoration demonstrates that although from an environmental point of view anthropic activity had an impact, the social effects of the heritage project favored social cohesion and community empowerment, enhancing civil pride and tolerance, thus stimulating tourism development and job creation. This study demonstrates that the life cycle approach can be considered an effective method for improving innovative sustainability managerial practices. The assessment is in some cases based on a subjective judgment, but the results provide a reliable overview of the social impact of the intervention.

Aspects related to the economic impact can be explored in further studies, by taking a life cycle-costing perspective. Possible developments could be the integration of environmental LCA, S-LCA, and LCC in cultural heritage interventions.

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Original article

Improving sustainable cultural heritage restoration work through life cycle assessment based model

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ABSTRACT

Sustainable restoration process is one of the biggest challenges for public and private decision makers in the Cultural Heritage sector. Currently, sustainability assessment methods are well established tools to quantitatively determine their environmental (LCA), economic (LCC) and social (SLCA) impacts from products/service across the entire value chain. Nevertheless, while these life cycle methods are widely applied in many industries and service sectors, they still are at its infancy in the restoration work of Cultural Heritage. The main goal of this paper is to define and build a general framework including all impact indicators related to the restoration work processes to apply experimentally, and for the first time, all the sustainability assessment dimensions together within the Cultural Heritage sector. The ISO 14040 standard under guidelines published by the UNEP/SETAC Life Cycle Initiative has been used as an assessment tool. Then, a CH-LCM Model framework based on a previous work from the author is applied to the real case concerning the restoration of the fortress of Uncastillo (Spain). The data collected from the real case concerning the restoration of the fortress of Uncastillo (Spain) have allowed us to reach two objectives: firstly, to validate the model empirically and, secondly, to identify successful managerial practices for the decision makers. In this respect, the paper shows that the life cycle approach can be considered an effective method for improving innovative managerial practices towards the sustainability, preservation and restoration of Cultural Heritage by assessing the environmental impact, the financial and economic feasibility and the implementation of an engagement strategy for the stakeholders. Finally, we have pointed out a set of valuable recommendations for future actions.

1. Introduction

The cultural sector is comprised of (and differentiated from) both the point of view of the resources and its protagonists as well. In addition, its examination from an economic perspective faces many problems in the delineation of the limits of culture as an economic activity. As a result, all these complexities have prevented the identification of the cultural sector in a universally accepted way and, thereby made its study a challenging one. In the economic field, the discipline that aims to study the production and consumption of culture is the so-called "culture economy" [1]

Within the discipline of the economy of culture, we can broadly distinguish three major areas of analysis: the performing arts, cultural industries and historical and cultural heritage [2]. This third one, cultural heritage, is the subject of this study. This sector presents many challenges since it is a key component to the identity of nations and, because of its uniqueness, carries with it the moral obligation to make it available to present and future generations [3].

In addition, due to its ethical and moral value of historical memory, Cultural Heritage must endure for future generations. This responsibility stimulates all the participants involved in its management of the adoption of a social responsibility orientation and, of course, a sustainable development over time [4].

The Cultural Heritage sector is a system that, due to its intrinsic nature, needs special attention when it comes to carrying out restoration and conservation of the works of art that compose it.

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Furthermore, these works of art possibly lead to more complex regulatory processes or "rules" in this sector because of the difficulties encountered in assessing the needs of multiple (economic) interest bearers, the safeguarding of their historical memory (social) and the respect for the territorial context (environmental) as a part of the technical problems. Therefore, this sector represents a great opportunity to reconcile social and environmental development with economic growth [5].

In the Cultural Heritage sector, as in other areas, sustainable development is not only a condition to be fulfilled when designing and implementing restoration work, but it also constitutes a process of directional change, through which the system radically improves orientation and makes it persistent over time [6]. The first step in this direction is to agree when this change represents an improvement, which may differ among observers who adopt different meanings of the concept of sustainable development, especially in the cultural heritage sector where there is a plurality of stakeholders.

Settembre Blundo et al. [7] describe Cultural Heritage as a set of multiple processes characterized by many Stakeholders interdependent among them, including individuals, companies and public institutions and, therefore, as paradigm of the so called complex socioeconomic systems [8].

Therefore, there may be several and different expectations related to the perception of sustainability that are manifested not only in its environmental dimension but also in terms of economic growth. This dilemma is solved by understanding sustainable development as a qualitative process of concretizing the potential of the present and future sector while growth is measured in terms of quantitative increase of its wealth [9].

Bennett et al. [10] argue that the Cultural Heritage and Sustainability are concepts intertwined in a perspective in which human activity is the sum of the legacies of the past and the future potentials. In doing so, sustainability represents one of the main challenges in the management of Cultural Heritage today. Therefore, the challenge for decision-makers is, on the one hand. to combine the needs of society with the obligation to protect the environment and natural resources, and on the other hand is to accompany sustainable development with future economic growth [11]. This objective can be achieved through the application of techniques such as the life cycle management (LCM) approach, which encompasses the three dimensions of sustainability that are environmental, economic and social ones [12].

In order to quantitatively analyze these three dimensions of sustainability there are specific methods: the life cycle assessment (LCA) to determine the environmental impact [13] the life cycle costing (LCC) to determine the economic impact [14]; and the social life cycle assessment (S-LCA) to determine the social impact [15].

The LCA analysis is standardized under the ISO 14040-14043 regulations, which provide the specific guidelines for conducting the environmental assessment [16]. According to ISO standards, the methodology is structured in four phases:

- goal, scope definition;
- inventory analysis;
- impact assessment;
- results interpretation.

The tool considers the entire life cycle of the product, process, or activity, for example, "from cradle to grave", starting with the extraction and processing of raw materials to its final disposal.

In the same vein, LCC is shaped according to the structure of LCA following ISO 14040, in four similar phases:

- goal, scope definition;
- inventory costs;
- aggregate costs by cost categories;
- results interpretation.

LCC methodology converts the environmental impacts into monetary units and it can also provide an additional information to decision makers for evaluating the economic and financial sustainability of a product or process [17].

Finally, the social dimension of sustainability takes into consideration the effects on the stakeholders involved along the life cycle processes, and it is evaluated by the S-LCA method [18]. Currently the S-LCA method is not yet formalized by international standards and analogously to the LCC, S-LCA adopts the phases specified by the ISO 14040 standard for the LCA and the same guidelines published by the UNEP/SETAC life cycle initiative [19].

Adding up all dimensions, Klöpffer [20] summarized the three-life cycle-based techniques in a new conceptual formula (LCSA = LCA + LCC + S-LCA) where LCSA is the life cycle sustainability assessment. LCSA extends the scope of current environmental LCA to embrace the other two dimensions of sustainability in order to understand the fundamental interactions between nature and society [21].

It is a stated fact that the current scientific literature does not provide clear evidence related with integrated applications of the three dimensions of life cycle approach to Cultural Heritage. Nevertheless, there have been some interesting attempts such as the one focusing on social impacts of cultural services from Arcese et al. [22] where a theoretical framework was developed for the evaluation of social impact on the Cultural Heritage sector, through the application of SLCA methods by previously classifying the stakeholder subcategories in order to improve consistency analysis.

In another recent study, the LCA approach was combined with LCC and S-LCA methods in order to design a conceptual protocol called "Cultural Heritage Life Cycle Management" (CH-LCM) that defines methodological guidelines to assess the sustainability of restoration processes [7].

Despite all these recent attempts, a more comprehensive approach and empirical evidence is needed to assess sustainability within the Cultural Heritage sector and this study tries to fulfil this gap by building up the results of these two studies and more particularly on the one on CH-LCM.

2. Research aim

The aim of this study is to validate the conceptual protocol of "Cultural Heritage Life Cycle Management" aforementioned, through its application to a practical case of Cultural Heritage restoration, in order to build an adequate operational model for the design and monitoring of restoration work on the Cultural Heritage in accordance with the three pillars of sustainability.

A case study will be adopted as the research application and conceptual assumptions represented in CH-LCM protocol (Fig. 1) have been used as a guide to evaluate and identify the environmental, economic and social impact that derives from restoration of Cultural Heritage.

In this research, the "operational validation" has been applied as the paradigm for obtaining a satisfactory valid model. According to Sargent [23] in the modelling process, the operational validation "is defined as determining that the model's output behavior has sufficient accuracy for the model's intended purpose over the domain of the model's intended applicability".

It will be used as an output for the model validation process, a specific framework composed of impact indicators for the

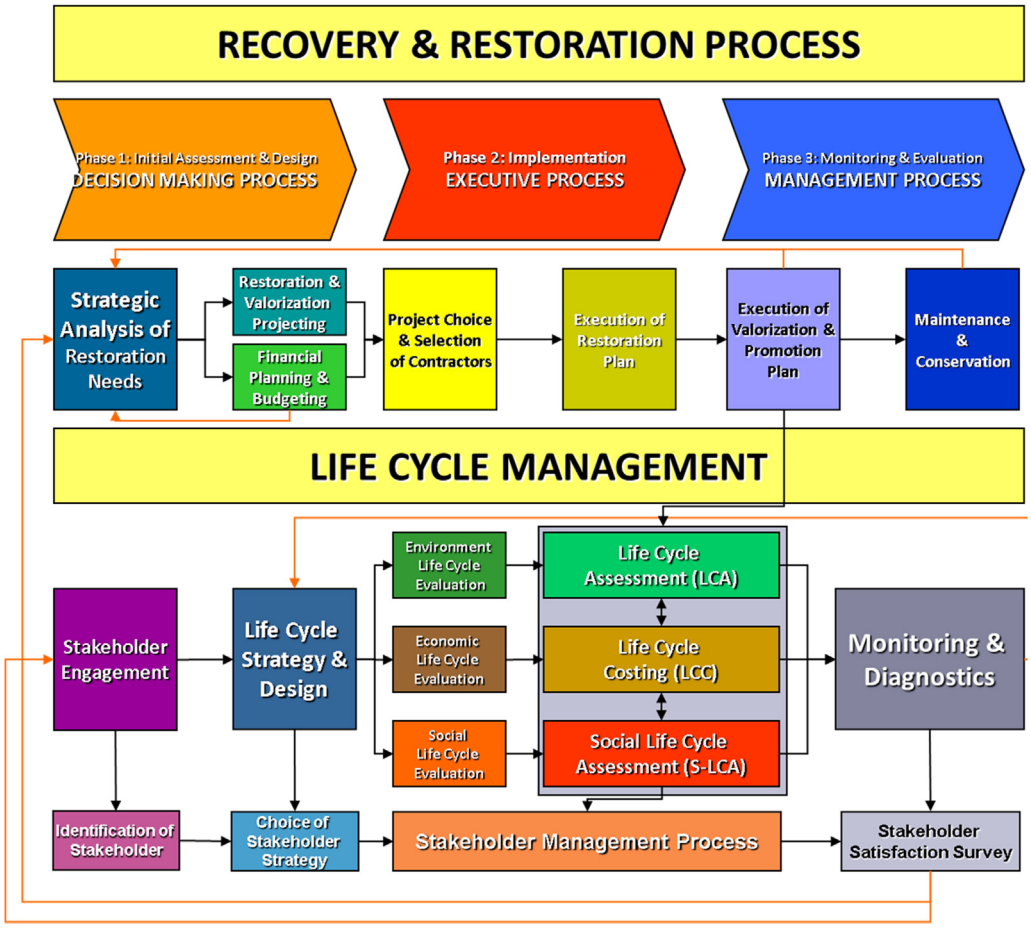

Fig. 1. Protocol of Cultural Heritage–Life Cycle Management.

Source: Settembre Blundo et al., 2014.

environmental, social and economic dimension in Cultural Heritage restoration work.

3. Materials and methods

3.1. CH-LCM conceptual protocol

The process of recovery and restoration is a recursive process and it consists of a set of phases, often sequential, linked by relationships that are developed over time: decision-making process, executive process and management process (see upper part of the Fig. 1).

Decision-making is a step-by-step process of making choices by identifying a decision, gathering information and assessing alternative resolutions for the actions of restoration, conservation and valorization, as well as economic and financial plan.

Based on the information collected and processed in the decision-making process, the executive process deals with the selection and implementation of the restoration project through the selection of contractors and the effective execution of the work.

The management process includes a set of activities that begin at the end of the restoration, in order to ensure the functionality of the Cultural Heritage over time, until a new restoration will be required. Therefore, at this stage it is expected to take place both the implementation of the valorization plan as well as the conservation and maintenance activities of Cultural Heritage.

For each stage of the Cultural Heritage the management process described above, it is possible to estimate not only the environmental (LCA) and economic (LCC) impacts but also the social ones (SLCA), in general and for each category of stakeholder. See the bottom of the Fig. 1.

We can consider the decision-making process strategic, because with it we define different alternatives of restoration for which, thanks to multiple cycles of LCSA, we can predict the environmental and socioeconomic impacts. This is also thanks to the identification and mapping of the stakeholders involved in the process of recovery and restoration of Cultural Heritage.

The essence of decision-making phase is to choose among alternatives elaborated during previous analysis and the selection and implementation phases of the project, which, at the time, can be considered more suitable for environmental, economic and social context in which the Cultural Heritage is placed. At this stage, we consider it appropriate to establish a prioritization of stakeholders mapped previously, in order to define and implement the most appropriate engagement strategy.

The life cycle approach adopted, which is based on the CH-LCM model, allows the restoration process not to close after the work, but to monitor the state of conservation of Cultural Heritage with the ability to repeat LCSA cycles to control the fulfillment of the objectives of protection, environmental economic and social sustainability as defined in the previous strategic planning (decision making). In this way the restoration by linear process effectively becomes a cyclic one.

The protocol CH-LCM is then formed from the integration of impact assessment tools, at all stages of the Cultural Heritage restoration process. Usually, mainly in industrial environments, impact assessment tools are used separately, and priority is given to environmental impact assessment using the LCA tool. The adoption

rather than an integrated approach (also using LCC and SLCA tools) shows how the involvement of stakeholders and the satisfaction of their expectations requires the integration of different historical, artistic, technical and managerial skills in the restoration process. This need promotes a synergistic cooperation between the various professionals involved in the restoration of Cultural Heritage. Moreover, this integrated approach also enriches the collection of information on the restoration process, which is no longer purely technical, but also economic and social. Finally, the adoption of the life-cycle approach also makes it possible to carry out periodic impact assessments after restoration work during the valorization phase, thus introducing a new form of monitoring before further restoration work.

3.2. Case study

Uncastillo is a Spanish village belonging to the region of Cinco Villas, in the province of Zaragoza (Autonomous Community of Aragon). Its fortress is symbol and emblem of the village, and it was built on a rocky hill that dominates the valley and strongly characterizes the landscape. The history of the fort dates to the tenth century AD, when a wooden "castrum" was built for defensive purposes, to counter Muslim expansion. In 1998 the Uncastillo Foundation was born with the aim of contributing to the preservation and promotion of the Cultural Heritage of the village.

The Uncastillo Foundation proves to be the ideal example for the application of the CH-LCM protocol to a specific case of Cultural Heritage. This is because it is a complex socio-economic system, where relationships among its multiple stakeholders are constituted under a Public Private Partnership [24] model that, moreover, is part of a specific territory that encompasses the town and its surroundings. This is a unique example at a reduced scale containing all the ingredients of a complex socio-economic system such as a multitude and diversity of stakeholders with different starting situations but with a common final objective: environmental, economic and social sustainable development of the territory.

Since the early 2000s, the Foundation has put in place a recovery plan for the fortress that included the restoration of the tower and the Gothic palace to be used as museums of medieval and local history. After carrying out the restoration intervention, the complex was finally assigned as a Museum of Medieval and Local History. The function of the building is mainly representative and monumental of historical evidence. It is a very strong point of reference and identification for the people, the strength is its very origin and its name: "Unum Castrum" (Uncastillo). Therefore, the project aims to preserve the good in the most authentic way to maintain these characteristics, and to improve it by allowing the use as a museum for the local population and visitors, which means that the whole territory benefits from a social and economic point of view.

In a general framework of design of the strategic plan for the management of Cultural Heritage of the entire village of Uncastillo, in collaboration with the Foundation, we have begun the validation of the CH-LCM protocol with a control LCSA of the restoration of the fortress, already carried out as mentioned above, which may serve as a predictive basis for the successive management of the whole village of Uncastillo.

4. Calculation

4.1. LCA: goal and scope definition

The goal is the environmental impact analysis of the restoration of a historic complex, founded in the 10th century: the fortress of Uncastillo.

4.1.1. System studied

The system studied is the fortress of Uncastillo, especially the architectural ensembles built by the "Homenaje" Tower (Tower of Keep) and the Palace of Pedro IV, including the tourist way that goes from the road of Sádaba to the two buildings.

4.1.2. Function of the system

The function of the system is being a historical evidence: the fortress represents the origin of the town and it is a landmark and a strong point of cultural identification for the population. The intervention has the aim to preserve and enhance the complex to maintain these characteristics.

4.1.3. Functional unit

The functional unit considered in the study is the complex formed by the "Homenaje" Tower, the palace of Pedro IV and the path from the road outside the walls. It encompasses a period of 100 years of useful life to be managed through a life cycle analysis model.

4.1.4. System limits

The limits of the system include the materials, components and technological elements used for the restoration work of the "Homenaje" Tower and the Palace of Pedro IV, and those used for the preparation, reception and access of visitors (tourists), the consumption of energy using buildings and the transportation of materials to the construction site. The components used are mainly raw materials. The system includes the phase of use of the restored building, therefore, energy and water consumption are considered among the "inputs" as well as the effects of its use for more than 100 years. Likewise, the useful life of the materials is considered for more than 100 years including its transport to the maintenance plants and the elimination operations. The system boundaries do not include the existing building, all restoration or rehabilitation operations carried out before.

4.1.5. Data quality

The data on the quantity and quality of materials and technologies used in the interventions come from primary sources, obtained from measures, reports and the processing of graphics in the executive implementation of the project where the data used was obtained ad hoc or extrapolated from the Eco-invent database [26]. The study was performed using SimaPro® 8.0.2 software.

4.1.6. Environmental impact assessment methodology

The method of analysis and evaluation used was Impact 2002+ V2.11 [25].

4.2. LCA: inventory analysis

It is the phase of the LCA in which the data corresponding to the inputs and outputs are collected for all the processes of the product system. The consumption of raw materials and energy, air and water emissions, and the treatment of decommissioned elements were considered with reference to the functional unit. In particular, the work is divided into the following three macro processes: Tourist access, "Homenaje" Tower (Tower of Keep) and Palace of Pedro IV.

4.3. LCA: impact categories

The first step within the framework of an LCA is the selection of environmental impact categories to be considered in the study. For this case study, we have selected the categories of environmental impact categories listed in the first column of Table 1, all

Table 1
Results of the LCA analysis for each restoration process detailed by each impact category and expressed in Pt.

LCA				
Impact categories	Tourist access recovery	Restoration of Homenaje Tower	Restoration of Pedro IV Palace	Total
Carcinogenic agents	0.228	1.547	5.471	7.246
Non-carcinogenic agents	0.124	2.621	3.7253	6.4703
Respiratory inorganic	3.433	20.527	121.537	145.497
Ionising radiations	0.008	0.092	0.2888	0.3888
Ozone depletion	0	0.001	0.008	0.009
Respiratory organic	0.003	0.02	0.065	0.088
Aquatic ecotoxicity	0.004	0.127	0.11	0.241
Terrestrial ecotoxicity	0.285	3.615	4.895	8.795
Soil acidification	0.04	0.243	1.148	1.431
Land occupation	0.051	0.318	0.651	1.02
Aquatic acidification	0	0	0	0
Aquatic eutrophication	0	0	0	0
Global warming	2.08	13.317	70.169	85.566
Non renewable energy	1.749	10.097	51.611	63.457
Mineral extraction	0.06	0.341	0.236	0.637
Total	8.065	52.866	259.915	320.846

Source: our elaboration.

Table 2
Association between impact and damage categories according to Impact 2002 + methodology.

Impact categories	Damage categories
Carcinogenic agents	Human health
Non-carcinogenic agents	
Respiratory inorganic	
Respiratory organic	
Ozone depletion	
Ozone depletion	Ecosystem quality
Aquatic ecotoxicity	
Terrestrial ecotoxicity	
Aquatic acidification	
Aquatic eutrophication	
Soil acidification	
Land occupation	
Global warming	Climate change
Non renewable energy	Resources
Mineral extraction	

Source: our elaboration.

of them contemplated by the Society of Environmental Toxicology and Chemistry (SETAC).

According to ISO14044, the LCA results are classified in impact categories, each with a category indicator must be linked to category standards. In our case, as previously mentioned, the Impact 2002+ methodology has been applied, which proposes the application of a combined approach of categories of impact with categories of damage. This links all types of LCA results by fifteen impact categories with four categories of damage (Table 2).

4.4. LCC: goal and scope definition

The system studied, the function of the system, the functional unit and the limits of the system are the same as those described for the LCA. Regarding data quality, the compilation was done by means of primary data provided completely confidential by the Uncastillo Foundation. As this data is sensitive, it is presented in this section in aggregate form. As a calculation tool, Microsoft Excel® spreadsheets designed specifically for this purpose have been used.

4.5. LCC: inventory costs

Likewise, to the preceding LCA, all the relevant costs have been considered, with reference to the functional unit, for the three macro processes already described above: Tourist access, Homenaje Tower and Palace of Pedro IV. Within an integrated technology

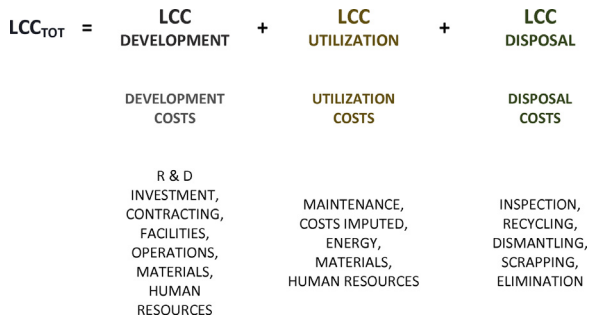

Fig. 2. Composition of life cycle costs in an industrial process.
Source: Sell et al., 2014.

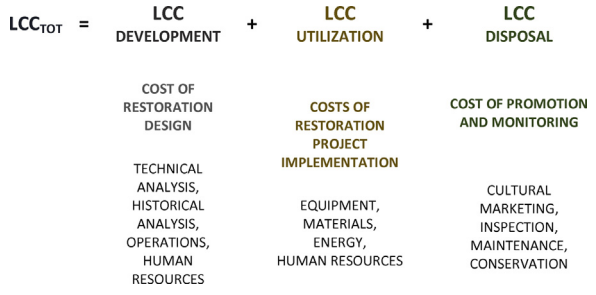

Fig. 3. Composition of life cycle costs in a recovery and restoration processes.
Source: our elaboration on Sell et al., 2014.

process and the product/service, the life cycle costs consist of the sum of individual costs during product/service development, use and disposal phase [27] as shown in Fig. 2. During the development and implementation of new technology (or process alternative), the main costs are research and development, investment and acquisition of equipment, as well as the costs of installation and start-up of equipment and related materials and human resources. The LCC cost scheme, previously described and typical of an industrial process, has been designed adapting it to the process of managing the Cultural Heritage, as expressed in Fig. 3, taking as reference the phases of the recovery and restoration process of Fig. 1. Thus, in the design phase of the different restoration options to choose from, the costs are attributable to the costs of technical and historical analysis and especially to the human resources involved in the study and planning of possible projects. While effective "production" is the implementation phase of the recovery and restoration

project that "decision makers" have chosen from the alternatives designed in the previous phase. Here the costs are technical: equipment, materials, energy and human resources. After the recovery of the Cultural Heritage, the expenses of the third phase are due to the marketing activities for the fruition of it and the costs of monitoring the artistic work in order to ensure its conservation over time.

4.6. S-LCA: methodological choices

The S-LCA technique has the same structure based on the ISO 14040 as the LCA and LCC ones, although applied to social issues. Therefore, assuming the same Goal and Scope of previous assessments, we adopted the participatory approach [28] of social actors involved in the management of Cultural Heritage, in order to establish and rank the impact categories collectively. As socioeconomic indicators relevant to the Uncastillo Fortress rehabilitation and restoration project and in accordance with the CH-LCM protocol, the expectations of the main Stakeholders have been adopted.

The first step of the participatory approach consists of selecting stakeholders. For the operational identification of the Stakeholder we have used an adaptation of the tools contained in the guidelines of the AA1000 "Accountability Principles Standards" (AA1000APS). These guidelines were published in 1999 and provide a framework for organizations to identify, respond and prioritize their sustainability challenges [29]. The AA1000 standard is a liability standard focused on ensuring the quality of social and ethical accounting, auditing and reporting [30]. In this way, and in accordance with the SETAC/UNEP guidelines, we have identified the stakeholders involved in the management of Cultural Heritage adopting the principles of Responsibility, Influence, Proximity, Dependency and Representation described in AA1000 standard. Table 5 shows the correspondences between the groups defined by the SETAC/UNEP guidelines and groups (and subgroups) of stakeholders of Cultural Heritage.

The second step (data collection) was carried out through interviews with main stakeholders to identify their expectations with respect to the restoration of the Uncastillo Fortress. The qualitative information was matched with data from the analysis of the relevant literature with the aim to prioritize the stakeholders in the next steps.

The third step was developed through multiple focuses of our research group, which represent different skills: scientific-technological, socio-economic, and historical-humanistic. The fourth step was taken with the organization of a meeting between the members of our research team and the main stakeholder, celebrated in Uncastillo on May 1st 2015.

In the fifth step, we adopted a metric approach to build a relationship between the expectations of stakeholders and the impact they have on the restoration project. Therefore, after the mapping of the stakeholders, we have prioritized them, in order to better design the most timely inclusion strategy. To carry out this work, the relevance of the expectations of the bearers of interest are translated into a prioritization index by means of the criteria of power, urgency and proximity already described in the AA1000 standard.

5. Results and discussion

5.1. LCA: impact assessment

Table 2 shows the impact evaluation results for each of the three processes and the total expressed by Weight Factor (Pt), while in the diagram of Fig. 4 the same values are shown graphically. In general, the process produces an impact of 321 Pt due to 81% to the restoration of the Palace, 16.5% to the restoration of the Tower, and 2.4% to the settlement of access to the monumental complex.

Table 3 shows the impact data for each category of damage and for the three restoration processes of the Fortress. The greatest impact for all work corresponds to the category of damage to human health. The detrimental effect on human health is mainly related to the NOx (nitrogen oxide) emissions associated with transportation of building materials and stones from the extraction sites to the restoration site at Uncastillo (49.8% overall). Clearly the same NOx emissions affect climate changes (26.7% in total). In the category of damage to resources the main effect is related to the consumption of stones for the restoration of the structures of the walls of the tower and the palace and the material for the rehabilitation of tourist access.

Fig. 2 shows, in a comparative diagram, the results of the impact on the environment of the rehabilitation and restoration work of the monument. The results of the values are only presented in terms of aggregated data without detailing the specific impact for each phase of the restoration processes. Likewise, Fig. 5 shows the contribution to the environmental impact of the work for each rehabilitation and restoration process.

5.2. LCA: results interpretation

The impact values are low and correspond mainly to the use, and especially to transport, of stone materials in the restoration work. The most important thing here is to have made a quantitative diagnosis of the quality of the work that has been carried out in line with the principles of sustainability: selecting and implementing restoration solutions (materials and processes) aimed to achieve environmental, social and economic sustainability. This means using natural resources for restoration works at a sustainable rate and in an efficient and responsible manner, so that it can operate in a sustainable way for the valorization of the Cultural Heritage. All this in a context of "social equilibrium" where the expectations of the main stakeholders involved in the management of cultural heritage are satisfied. The fulfilment of these three requirements (environment, economy and society) can ensure that the community, which preserves the Cultural Heritage, an innovative path of sustainable development.

5.3. LCC: aggregate costs by cost categories

Table 4 shows the costs of restoration of the Fortress of Uncastillo relative to the Tourist Access, Tower and Palace, detailed by restoration work, expenses, benefits and VAT, with partial and general totals. In addition to these "gross costs" of work, it is

Table 3
LCA impact results of the restoration process by category of damages and expressed in %.

LCA				
Damage categories	Tourist access recovery	Restoration of Homenaje Tower	Restoration of Pedro IV Palace	Total
Human health	47.1	46.9	50.4	49.8
Ecosystem quality	4.72	8.14	2.62	3.58
Climate change	5.8	25.2	27	26.7
Resources	22.4	19.7	19.9	20

Source: our elaboration.

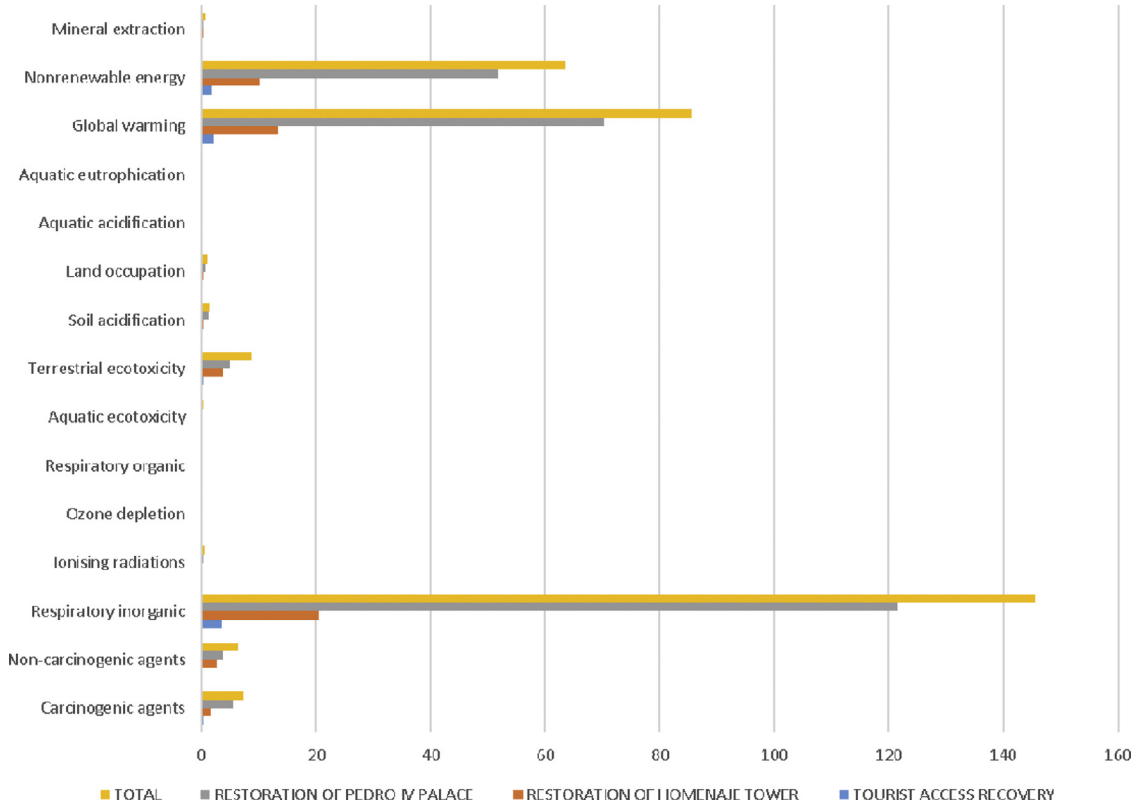

Fig. 4. Environmental profile diagrams for each restoration process detailed by each impact category and expressed in Pt.
Source: our elaboration.

Table 4
Costs of implementation of the restoration project due to work and externalities and expressed in euros.

	Restoration costs		
	Tourist access	Tower	Palace
Restoration works	8.311.282.00	8.310.37	107.823.50
13% costs	1.080.467.00	498.62	14.017.06
6% benefits	498.677.00	1.010.35	6.469.41
21% VAT	1.745.369.22	1.745.18	22.642.94
Subtotal	11.635.795.22	11.634.52	150.952.91

	Restoration costs		
	Tourist access Externalities	Tower	Palace
Human health	5.317.97	33.117.76	191.522.07
Ecosystem production capacity	−30.81	−182.22	−1.037.29
Abiotic stock resource	57.844.16	786.018.91	636.060.05
Biodiversity	47.73	267.68	1.230.42
Subtotal	63.179.05	819.222.13	827.775.25
			1.710.176.43

Source: our elaboration.

necessary to take into account the costs of impact on the environment and society that the restoration work has provided. The LCC analysis associated with the LCA allows translating environmental damage rates into economic damages. Every human activity consumes environmental goods (raw materials, energy, natural resources), in our case for the execution of the restoration work, but in fact neither accounts nor takes care of any cost for this side effect related to these processes.

This condition of use of environmental goods, not accompanied by payment for consumption, is known in economic terms as external costs or environmental externalities [31]. In this study externalities have been calculated using the Environmental Priority Strategies in Product Design (EPS2000) methodology, which is a harm-oriented approach. It takes into account the willingness to pay to restore the changes caused by any activity and/or process. Also in Table 4, it shows the economic valuation of externalities for each typology of work referred to each category of damage.

Negative externalities, i.e.: no impact costs, referred to the category “production capacity of the ecosystem” are due to the reuse of the existing stones for restoration work and conservation of architectural structures. Therefore, there was no lack of searching for new stone materials with consequent impact on the system. By means of this estimation we can understand how and how much human activity can impact the environment in economic terms on. Such an impact, of course, is higher in

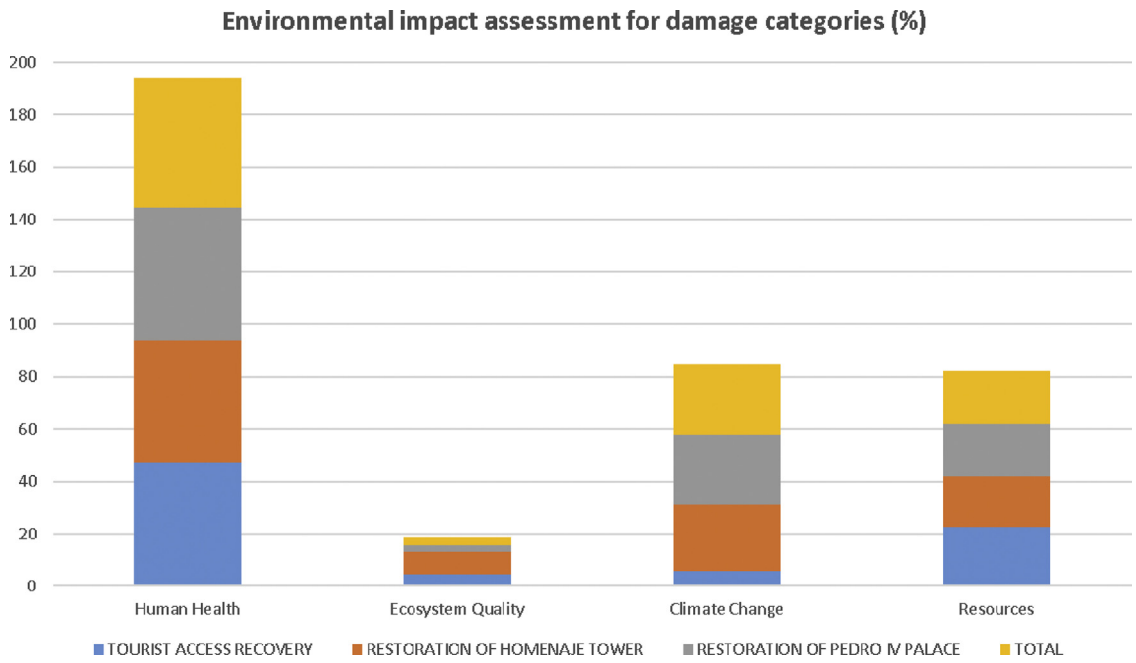

Fig. 5. Environmental profile diagrams of the restoration process by category of damages and expressed in %.

Source: our elaboration.

Table 5
Stakeholder mapping involved in the Uncastillo Fortress Restoration Project.

UNEP/SETAC	Groups	Subgroups
Subgroups	Companies of the restoration sector	Entrepreneurs
		Employees
		Professional restorers
Consumers	Citizens and organisations enjoying cultural heritage	Tourists
		Occasional visitors
		Scientists and scholars
Local communities	Local public institutions	City council of Uncastillo
		Community of Cinco Villas
		Provincial council of Zaragoza
		Autonomous community of Aragon
Society	State	Ministry of education, culture and sport
		General sub-directorate for the protection of the historical heritage
		General sub-directorate of the institute of cultural heritage of Spain
		General directorate of cultural heritage of government of Aragon
	Citizens and organisations	ARESPA, Spanish Association of historic heritage restoration companies
		College of surveyors, technical architects and building engineers of Aragon
		Uncastillo Foundation
		Patrons and sponsors citizens
		Patrons and sponsors organizations
		Citizens and organizations tax payers
		Residents of Uncastillo
		Future generations
	Other companies	Companies of the sector of the tourism in the community of Cinco Villas
		Construction companies in the community of Cinco Villas
Other value chain actors	R&D centers (Public and/or private)	University of Zaragoza

Source: our elaboration based on the SETAC/UNEP guidelines and the AA1000 standard.

the more complex restoration work, namely the Tower and the Palace.

Consequently, the total costs of implementation and execution of the restoration project are the sum of the costs of the restoration work and the externalities:

- 11.798.382,64 € + 1.710.176,43 € = 13.508.559,07€.

The costs of designing the restoration project correspond to 20% of the costs of implementation and execution of the work, i.e.:

- 2.701.711,81 €.

While the costs of promotion and monitoring correspond to 10% of the costs of implementation and execution of restoration work, i.e.:

- 1.350.855,91 €

In this way, we can apply the life cycle costing formula as shown in Fig. 6.

LCC_{Tot}		LCC Development		LCC Implementation		LCC Monitoring
	=		+		+	
	=	COST OF RESTORATION DESIGN	+	COSTS OF RESTORATION PROJECT IMPLEMENTATION	+	COST OF PROMOTION AND MONITORING
	=	2.701.711,81€	+	13.508.559,07 €	+	1.350.855,91€
					TOTAL LIFE CYCLE COSTING:	17.561.126,79 €

Fig. 6. Composition of the life cycle costs in the process of recovery and restoration of Uncastillo Fortress.
Source: our elaboration.

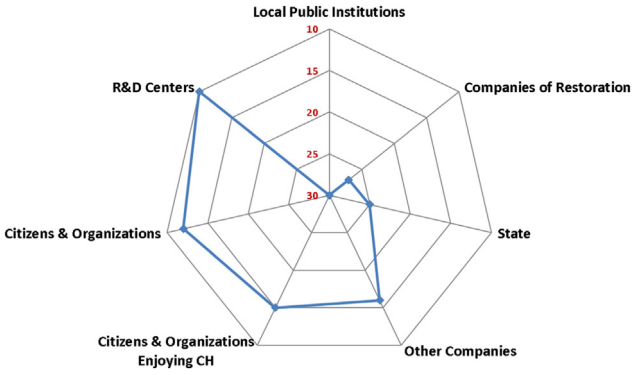

Fig. 7. Prioritization diagram of Stakeholders Groups.
Source: our elaboration.

5.4. LCC: results interpretation

Thanks to the potential of the LCC we have been able to add to the costs of designing, implementing and executing the restoration project of the Castle Fortress, the costs that the environmental and social system must pay for this work. In other words, we have transformed the externalities into internal costs that can be taken into account in the decision-making process, reaching beyond the capital and operating costs of work. In this way, it is possible to extend the limits of the perimeter system of the work to the environment directly and indirectly involved in the process of management of Cultural Heritage.

5.5. S-LCA: social inventory analysis

Table 6 shows how, a priority interest rate (1 to 10) for each criterion is assigned to a stakeholder group until a total prioritization index, obtained by the sum of the partial indexes, is determined. The deviation indicates how far the total index of the maximum prioritization value goes (30 = 10 + 10 + 10). The following Table 7 shows the list of stakeholder groups sorted by decreasing index and the corresponding weighting factor calculated by dividing the prioritization index by the maximum prioritization value. The radial diagram of Fig. 7 more clearly represents the relative relevance of the different stakeholders to the maximum prioritization value (to the center of the diagram). Logically the local public institutions, the state and the companies that participate in the restoration work have relevant interests regarding the project of recovery and management of the Fortress of Uncastillo. The successive step is to give a prioritization index to each stakeholder weighted by means of the weighting index of the corresponding group. The results are shown in Table 8. In this way, each stakeholder has an index of prioritization, that is to say of relevance, with respect to the development of the project of restoration and recovery of the Fortress of Uncastllio. As in the previous case, it is possible to design a list of the stakeholders (Table 9). The weighted listing allows us to aggregate the interest bearers into four groups with different priority ranges by which it will be possible to design an appropriate inclusion strategy. The Uncastillo Foundation is in the Priority Group n.2, although due to its degree of involvement in the project it should be at the highest priority level.

5.6. S-LCA: results interpretation

Through the participatory approach we have selected the main stakeholder groups whose expectations represent the social indicators of impact. The success of planning efforts for the restoration of the Fortress of Uncastillo depends on consensus and support among the stakeholders, therefore it is important that stakeholders with an interest in the project play an active role in its development and should be aware that their expectations have been heard and understood.

6. Conclusions and suggestions

The purpose of this paper was to validate the conceptual protocol of “Cultural Heritage Life Cycle Management” turning it into a model and demonstrating that it is also a good tool for the maintenance, conservation and restoration work of Cultural Heritage.

We were able to empirically validate the conceptual protocol CH-LCM, getting a management model of cultural heritage in accordance with sustainability criteria, empowering the decision-makers, to design an impact assessment framework for restoration work.

Through this research and for the first time we have been able to integrate into a single operational model, the environmental (LCA), economic (LCC), Social (S-LCA) impact assessment tools along with the main steps of the process of recovery and restoration within the Cultural Heritage sector.

In conclusion, several implications for both scholars and practitioners emerge from our study.

Building on our case study results, we can show some findings that may be of interest to scientists devoted to theoretical research on the management of Cultural Heritage such as:

- how to build a quantitative assessment of environmental, economic and social impact of the entire restoration process;
- the definition of criteria and methods for identifying, prioritizing and engaging all stakeholders at every stage of the restoration, conservation and valorization process;
- the design of a complete framework of the impact indicators for the sustainable restoration of Cultural Heritage.

Finally, from a managerial point of view, the new model of Cultural Heritage Management, through its application to the case study of Uncastillo, has proven to be able to:

- relate the different points of view of technical specialists (historical, archaeological, chemical, physical, architects, engineers and economists) in a single integrated project for the management of Cultural Heritage;
- provide a constant source of information (technical, economic and social) to support decision-making;
- monitor, in a sustainable and innovative way, the state of conservation of Cultural Heritage during its life cycle.

This study is a part of our ongoing research to develop new models for sustainable management of Cultural Heritage and for this reason the major limitation of the work is to generalize the

findings we reported here from a single case study. The procedures for design and implementation of Cultural Heritage restoration require a very long time for development and therefore it is difficult to find an opportunity for empirical testing of theoretical research. Nevertheless, our research program includes the application of the model to other cases of Cultural Heritage restoration, as well as to transfer this new sustainable approach to other related sectors such as the construction one.

Table 6
Priority indices of Stakeholders Groups.

Stakeholders	Power criterion	Urgency criteria	Proximity criteria	Total prioritization index	Deviation %
Companies of restoration	7	10	10	27	10
Citizens & organizations enjoying CH	4	6	5	15	50
Local public institutions	10	10	10	30	0
State	9	9	7	25	17
Citizens & organizations	4	4	4	12	60
Other companies	5	6	5	16	47
R&D centers	3	4	3	10	67
Maximum prioritization	10	10	10	30	0

Source: our elaboration.

Table 7
Prioritization of stakeholders groups.

Priority	Stakeholders	Total prioritization index	Weighting factor
1	Local public institutions	30	1.00
2	Companies of restoration	27	9.90
3	State	25	0.83
4	Other companies	16	0.53
5	Citizens & organizations enjoying CH	15	0.50
6	Citizens & organizations	12	0.40
7	R&D centers	10	0.33

Source: our elaboration.

Table 8
Prioritization of stakeholders with weighted indices.

Stakeholders	Power criterion	Urgency criteria	Proximity criteria	Weighting factor	Total prioritization index
Entrepreneurs	7	9	10	0.90	23
Employees	5	5	9	0.90	17
Professional restorers	8	9	10	0.90	24
Tourists	3	2	3	0.50	4
Occasional visitors	2	2	2	0.50	3
Scientists and scholars	3	2	3	0.50	4
City council of Uncastillo	10	10	10	1.00	30
Community of Cinco Villas	5	4	4	1.00	13
Provincial council of Zaragoza	8	4	3	1.00	16
Autonomous community of Aragon	10	7	8	1.00	25
Ministry of education, culture and sport	7	4	2	0.83	11
General sub-directorate for the protection of the historical heritage	8	4	3	0.83	12.45
General sub-directorate of the institute of cultural heritage of Spain	9	4	3	0.83	13.28
General directorate of cultural heritage of government of Aragon	10	6	6	0.83	18.26
ARESPA, Spanish Association of historic heritage restoration companies	3	3	2	0.40	3.2
College of surveyors, technical architects and building engineers of Aragon	3	3	2	0.40	3.2
Uncastillo Foundation	10	10	10	0.40	12
Patrons and sponsors citizens	4	2	4	0.40	4
Patrons and sponsors organizations	4	2	4	0.40	4
Citizens and organizations tax payers	2	2	2	0.40	2.4
Residents of Uncastillo	4	6	6	0.40	6.4
Future generations	1	6	6	0.40	5.2
Companies of the sector of the tourism in the community of Cinco Villas	4	7	7	0.53	9.54
Construction companies in the community of Cinco Villas	4	7	7	0.53	9.54
University of Zaragoza	3	3	3	0.33	2.97
Maximum prioritization	10	10	10	30	0

Source: our elaboration.

Table 9
Stakeholders list with weighted prioritization indexes.

Priority	Stakeholders	Total prioritization index	
1	City council of Uncastillo	30	Priority group 1
2	Autonomous community of Aragon	25	
3	Professional restorers	24.3	
4	Entrepreneurs	23.4	
5	General directorate of cultural heritage of government of Aragon	18.26	Priority group 2
6	Employees of restoration companies	17.1	
7	Provincial council of Zaragoza	16	
8	General sub-directorate of the institute of cultural heritage of Spain	13.28	
9	Community of Cinco Villas	13	
10	General sub-directorate for the protection of the historical heritage	12.45	
11	Ministry of education, culture and sport	12	
12	Uncastillo Foundation	10.79	
13	Tourism companies in the Community of Cinco Villas	9.54	Priority group 3
14	Construction companies in the Cummunity of Cinco Villas	9.54	
15	Residents of Cinco Villas	6.4	
16	Future generations	5.2	
17	Tourists	4	Priority group 4
18	Scientists and scholars	4	
19	Patrons and sponsors citizens	4	
20	Patrons and sponsors organizations	4	
21	Occasional visitors	3.2	
22	University of Zaragoza	3.2	
23	ARESPA, Spanish Association of historic heritage restoration companies	3	
24	College of surveyors, Tech. Architects and building engineers of Aragon	2.97	
25	Citizens and organizations taxpayers	2.4	

Source: our elaboration.

Acknowledgment

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30 November 2018

Dear Dr. Settembre Blundo:

It is a pleasure to accept your manuscript entitled "Sustainability as Source of Competitive Advantages in Mature Sectors: The Case of Ceramic District of Sassuolo (Italy)" in its current form for publication in Smart and Sustainable Built Environment. The comments of the reviewer(s) who reviewed your manuscript are included at the foot of this letter.

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Thank you for your contribution. On behalf of the Editors of Smart and Sustainable Built Environment, we look forward to your continued contributions to the Journal.

Yours sincerely,
Prof. Rob Roggema
Editor, Smart and Sustainable Built Environment rob@cittaideale.eu

Reviewer(s)' and Regional Associate Editor Comments to Author:

Reviewer: 1

Recommendation: Accept

Comments:

Dear author(s) your article could be extended into a second part as a future line of research based on product, process and business model innovation within this field

Additional Questions:
1. Originality: Does the paper contain new and significant information adequate to justify publication?: Yes, the paper contributes significantly to the knowledge with the use of most advanced theories on sustainability and circular economy. Besides, it proposes a shift in a focus analysis from the micro to the meso level and introduces innovative methodologies of study

2. Relationship to Literature: Does the paper demonstrate an adequate understanding of the relevant literature in the field and cite an appropriate range of literature sources? Is any significant work ignored?: There is a holistic understanding and use of the literature in the field to understand the interrelations among the different and complex analysis. As a result, an extended bibliography has been generated on Sustainability as well as on a new business model proposal based in the Circular Economy. Therefore, the research is quite thorough and no significant work is ignored.

3. Methodology: Is the paper's argument built on an appropriate base of theory, concepts, or other ideas? Has the research or equivalent intellectual work on which the paper is based been well designed? Are the methods employed appropriate?: This point has been covered above stating the multiple integration of analytical theories on Sustainability, Circular Economy and Process Innovation. These theories have been addressed with sound and well-established methodologies such as the LCSA, LCA, LCC and S-LCA supported by the ISO standards and a new development on Circular Economy called CBM (Circular Business Model) applied to the study and process innovations such as the software SimaPro 8.0.2 and the IMPACT 2002 evaluation method.

4. Results: Are results presented clearly and analysed appropriately? Do the conclusions adequately tie together the other elements of the paper?: Yes, the authors fulfilled the requests of the four research objectives of the study with the proposed methodology (in brackets): (1) What are the process factors that most influence the environmental impact of the ceramic products (LCA), (2) How do these impacts affect the structure of industrial costs (LCC)? (3) What are the expectations of the main stakeholders (S-LCA) and (4) How sustainability principles are introduced into business models (CBM).

Nevertheless, the conclusions could have been many more given the depth and breadth of the analysis. The research results could have supported an extended conclusion and recommendation list. It is true that they are not covered in the objectives of the analysis but the feeling after reading it is that more could have been drawn. Thereby, it looks that it is room for a second part of the article and the suggestion is to include it as a future line of investigation deepening in product, process and more business model innovation.

5. Implications for research, practice and/or society: Does the paper identify clearly any implications for research, practice and/or society? Does the paper bridge the gap between theory and practice? How can the research be used in practice (economic and commercial impact), in teaching, to influence public policy, in research (contributing to the body of knowledge)? What is the impact upon society (influencing public attitudes, affecting quality of life)? Are these implications consistent with the findings and conclusions of the paper?: The implications for the research, practice and society are significant (less waste, recycling, lower cost, environment preservation) since it introduces a new holistic methodology and tests it in one of the best possible environments closing the gap between theory and practice: The Ceramic district of Sassuolo

6. Quality of Communication: Does the paper clearly express its case, measured against the technical language of the field and the expected knowledge of the journal's readership? Has attention been paid to the clarity of expression and readability, such as sentence structure, jargon use, acronyms, etc.: Nothing to say.

Regional Associate Editor
Comments to the Author:
Accepted as submitted in its revised version, congratulations.
My sincere apologies for the unnecessary delay - there was something wrong in the system, only recently solved.